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MONTANA OUTDOORS

"It is the desire of my heart to make this park the most wonderful land in the world."

—William R. Logan
(first superintendent, Glacier National Park)

MONTANA OUTDOORS

July/August 1985, Vol. 16, No. 4
(USPS 360 280)

Front Cover
For many visitors, a summer vacation to Montana is planned around piscine adventures—fishing. The sport has also become increasingly important to those who spend time in Montana's wilderness areas, such as the fisherman photographed by George Wuerthner at Grizzly Lake in the Selway-Bitterroot Wilderness Area.

Inside Front Cover
In Nelson Kenter's photograph, the scenic attributes of Glacier National Park's Hidden Lake country appeal to mountain goats, as well as to two-legged visitors.

Back Cover
In Neal Mishler's photograph, it's easy to see why Jeffery Steffens of Great Falls is proud of his rainbow trout.

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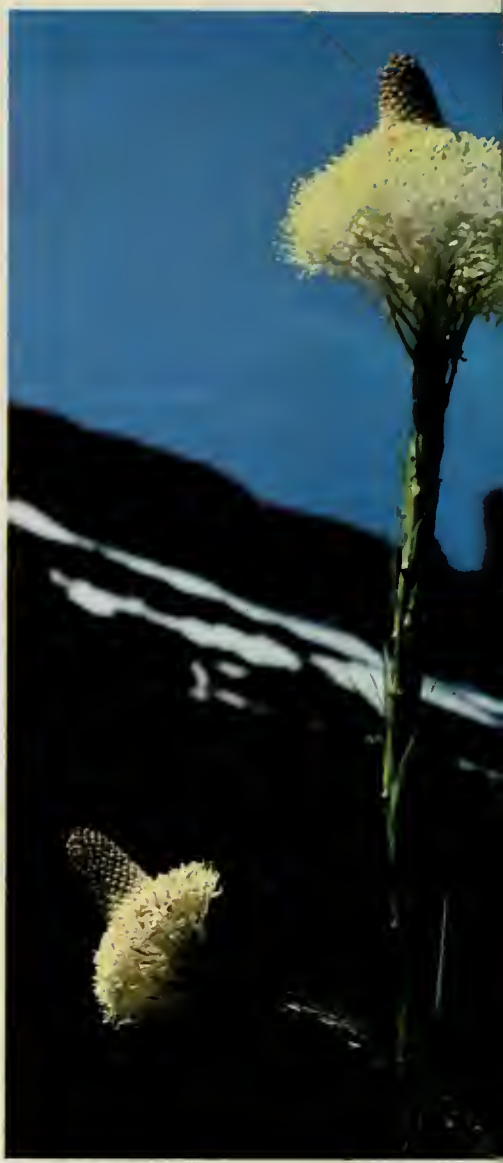


Beargrass, Mount Wilbur in background (JOYCE CLARK TURVEY)

Glacier Celebrates 75 Years

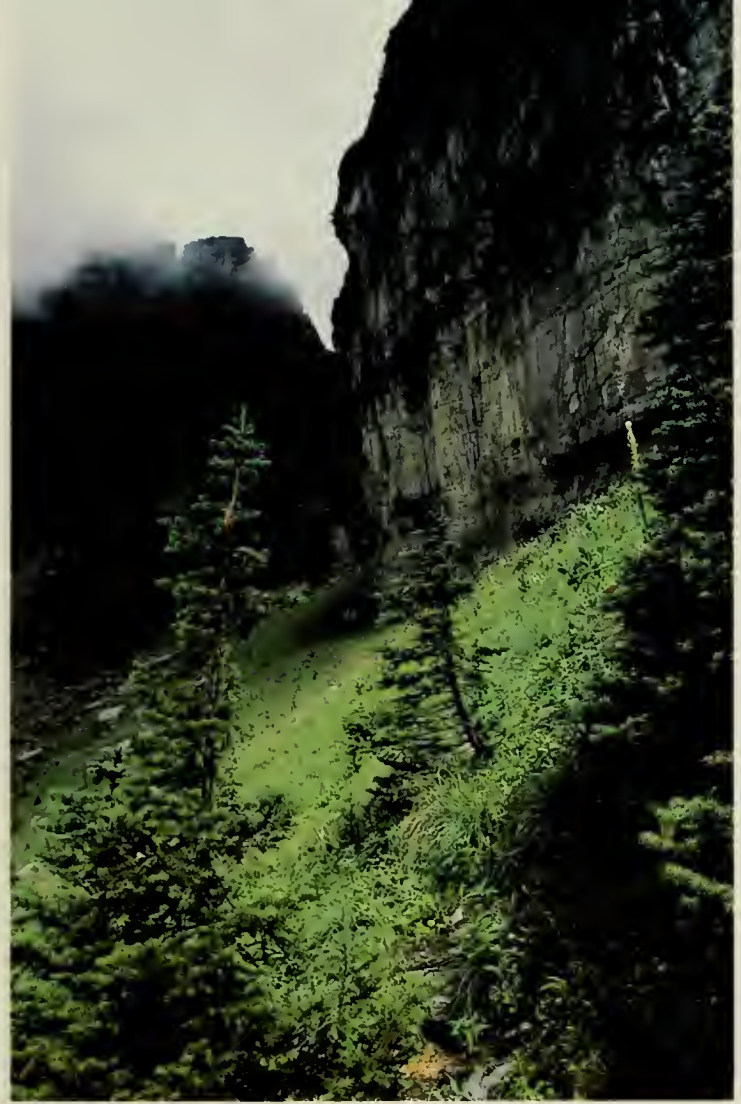
McDonald Lake (NELSON KENTER)

This year marks the 75th anniversary of Glacier National Park, a high-mountain jewel encompassing lofty crags, sculptured glacial valleys, pristine lakes, and wildflower meadows in the heart of Montana's northern Rockies. As early as 1883, Lt. John Van Orsdale, an army officer charged with exploring portions of the Pacific Northwest, made a plea for setting aside this unique area:

> A great benefit would result to Montana if this section could be set aside as a National Park. The country included in such a park is not fit for agricultural or grazing purposes, but by placing it under the protection of the Government the forests would be protected and consequently some of the sources of water of the three great river systems.

But it was not until 1910, after considerable effort on the part of many people, including naturalist George Bird Grinnell, lecturer and explorer Dr. Lyman B. Sperry, and railroad magnate James J. Hill, that the bill creating Glacier National Park was signed into law by President William Howard Taft.

Snow Cave, Going-to-the-Sun Highway (DAVE BOOKS)



Along Garden Wall Trail (GARY D. HOLMES)

Indian paintbrush (JACK OELFKE)

Glacier Park and its Canadian counterpart, Waterton Lakes, together compose Waterton/Glacier International Peace Park, more than a million acres of some of the most spectacular scenery on the North American continent. The area is home to numerous species of wildlife, including bighorn sheep, mountain goats, bald eagles, and grizzly bears.

Nearly 2 million visitors enjoyed Glacier in 1984, a substantial increase over the 4,000 who toured the park in 1911! Going-to-the-Sun Road, an engineering marvel more than a decade in the making, opened the heart of Glacier to tourist travel when it was completed in 1933. Traversing the park in an east-west direction, Going-to-the-Sun crosses the Continental Divide at Logan Pass, more than 6,000 feet above sea level.

Cow elk and calf (GORDON DIETZMAN)

A number of special activities are planned for Glacier's Diamond Jubilee celebration this summer. They include an exhibit of park history, an international flag-unveiling at Logan Pass Visitor Center, a special gift package for the 1 millionth park visitor, several parades in surrounding communities, a special interpretive slide program, and a living history portrayal of Grinnell, the "father of Glacier National Park."

Additional information on Glacier Park and the anniversary celebration can be obtained by writing: Superintendent, Glacier National Park; West Glacier, MT 59936, or phoning 406/888-5441. Additional information on Waterton Lakes is available by writing: Superintendent, Waterton Lakes National Park; Waterton Park, Alberta T0K 2M0, or phoning 403/859-2262. ■

(far left) St. Mary Lake, Going-to-the-Sun Mountain in background (JOYCE CLARK TURVEY)

Managing Fish On The "Mighty Mo"

by Rod Berg

Stretching 2,475 miles from its origin at Three Forks, Mont., to a confluence with the Mississippi near St. Louis, the Missouri is the nation's longest river. The 207-mile reach from Great Falls to Fort Peck Reservoir is unique because it is the last major free-flowing and unaltered portion. This remote and relatively inaccessible part of the Missouri has kept most of its primitive character. Through a gorgelike valley bordered by rough breaks and badlands, the river has carved its course between the Little Rocky, Bear Paw, and Highwood mountains.

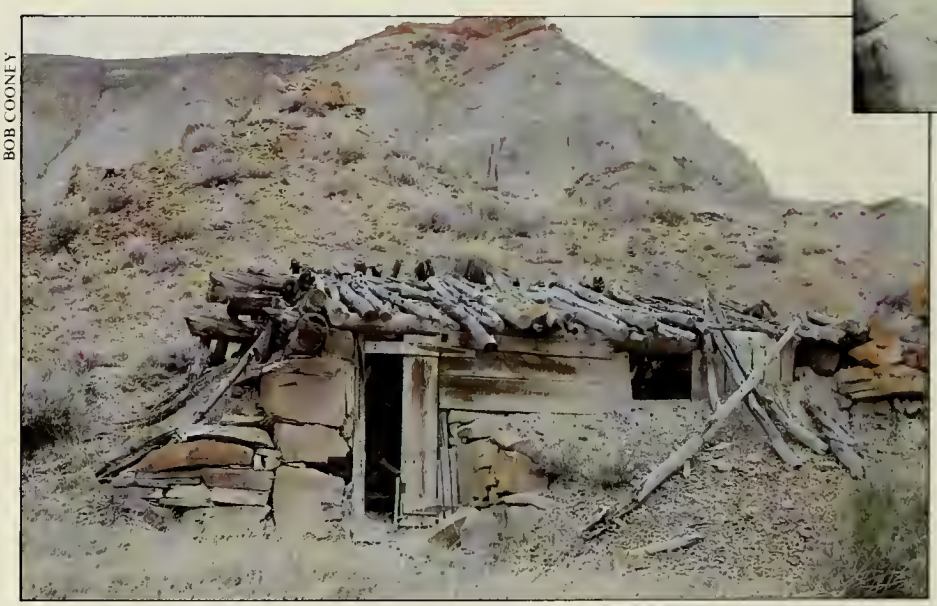
Today, floaters enjoy scenic vistas which remain much as first described by Meriwether Lewis and William Clark in 1805-06. Colorful history and romance on the Big Muddy are legendary, and history buffs can relive much of the excitement of the early explorers. With a little searching to find the rotting timbers and broken glass, one can find the unmarked sites of several early military posts—Fort McKenzie near the mouth of the Marias, and Camp Cook, Fort Chardon, and Fort Clagett near the mouth of the Judith. Fur trade flourished briefly in the early 1800s at the riverside trading posts of Forts Lewis, Benton, and Piegan. Steamboats plied the shallow waters as far as Fort Benton, bringing gold seekers and materials for an expanding economy.

Until the coming of the railroads in the late 1800s, the Missouri was the major route to the Rocky Mountain West. Some exceptionally scenic landmarks along the river recall those days of long ago. The names of Steamboat Rock, Hole-in-the-Wall, Dark Butte, and Citadel Rock ring with excitement and echo the romance of this period of westward expansion. Later, homesteaders found the Missouri River Valley an environment too harsh in which to pursue their livelihood. The frame and log dwellings they left behind are present-day reminders of dreams that were not to be.

TIM LUCAS

Whether your interest is in recreation (such as floating), or in scenery (such as the badlands through which the river has carved its course), or in history (as evidenced by the remnants of early-day settlement), the Missouri provides rich offerings.

BOB COONEY



The free-flowing river, protected as part of the National Wild and Scenic Rivers System, preserves not only scenery, solitude, and recreational opportunities, but also a bountiful fish and wildlife resource. Canada geese nest along the river in spring. Pelicans feed and bald eagles nest in the vertical cliffs above the water. Deer, coyotes, bobcats, beavers, and

muskrats abound along this entire stretch of river. There are elk and bighorn sheep along the lower portion below Cow Island, and in some places prairie dog towns dot the banks.

The Fishery of the Wild And Scenic Missouri

The fishery along this stretch of the Missouri is as varied as the wildlife, because the Missouri changes in character as it emerges from the mountains near Great Falls. Below the falls, the Missouri widens, the water is warmer, and it carries a heavy load of silt. While fishermen catch a few trophy-sized rainbow and brown trout in the Missouri below Great Falls, it is primarily a warm water fishery.

If one word could describe the fishery in the Wild and Scenic Missouri River, that word would be "diversity." Of the 85 species and 18 families of fishes found in Montana, 53 species representing 14 families are in this segment of the Missouri. Sauger, shovelnose sturgeon, channel catfish, burbot (ling), and paddlefish are the most common game fishes, and they comprise the bulk of the sport fishery.

Research conducted by the Department of Fish, Wildlife and Parks from 1976-80 reveals some interesting facts about the fish in the Missouri. Let's take a closer look at some of the key species:

Sauger

Sauger, also called sand pike, are the most common game fish in the Wild and Scenic Missouri. They are closely related and similar to walleye. Sauger prefer large rivers and turbid water, while walleye are more likely to be found in larger lakes and reservoirs with clearer water. Sauger outnumber walleye in the Missouri River by about 100 to 1.

Sauger spawn in the Missouri from mid-April through late May, when water temperatures reach 50°F to 55°F. Females deposit eggs at random in gravelly areas and leave them unattended until they hatch, in 12 to 18 days. The young sauger then drift downstream in the current until they reach suitable rearing areas, typically side channels and backwaters of the river. Young sauger feed mostly on aquatic insects and zooplankton, while adults feed almost entirely on smaller fish.

Our electrofishing and tagging studies showed sauger spawn primarily in a 30-mile reach of the Missouri River upstream from Fort Benton, and in the lower reaches of the Marias and Judith rivers, the principal tributaries of the Missouri. Sauger us-

ing these areas for spawning come from as far downstream as the headwaters of Fort Peck Reservoir, moving distances of up to 200 miles.

Sauger reach a length of about six inches after their first year in the Missouri, and they grow two to three inches per year during the remainder of their life. This growth rate is about average for sauger found in waters of the northern United States. The oldest and largest sauger we sampled in the Missouri was an 8-year-old, measuring about 24 inches long and weighing about 5¼ pounds.

Angling for sauger in the Missouri is good during the entire ice-free period which usually extends from late March through November, with the best catches in April, May, and September. Fishing for sauger is generally better in the upper portion of the river between Morony Dam and Coal Banks Landing. Hot spots include the 30-mile reach upstream from Fort Benton and the confluence areas and lower few miles of the Marias and Teton rivers near Loma. Fish can often be taken in shallow areas of the river when water temperatures are cooler in spring and fall; they are usually found in deeper water during the heat of summer. They can be caught on both bait and artificial lures; some of the more popular lures include striped or hammered brass spoons, spinners, and minnow or wounded minnow plugs; typical baits include night crawlers or cut-up strips of sucker or goldeye. The flesh of sauger is white, firm, and of excellent flavor; they are usually prepared for eating by filleting and pan- or deep-fat frying.

Shovelnose Sturgeon

The shovelnose sturgeon is a relatively primitive fish characterized by a shovel-shaped snout, a head covered with bony plates, five rows of bony scutes on the body, and a sharklike, upturned tail. Shovelnose are common in the Missouri between Loma Ferry and Fred Robinson Bridge.

Shovelnose spawn in the Missouri from late May through the middle of July, when water temperature ranges from about 60°F to 70°F. They spawn in the lower few miles of the Marias River and in portions of a 60-mile stretch of the Missouri between Carter Ferry and Little Sandy Creek. Recapture of tagged fish has documented spawning movements of over 100 miles in the Marias and Missouri rivers. The eggs, deposited over rocky or gravelly river bottom, hatch in about 10 days.

Shovelnose are a relatively slow-growing fish, but they are long-lived. In our study, sturgeon collected from the Missouri averaged more than 20 years of age, and they ranged up to 33 years old. The largest shovelnose sampled was a 30-year-old female weighing 13½ pounds and measuring about 45 inches long. The average sturgeon was about 32 inches long and weighed 5 pounds. This average size is considerably larger than the average size reported for other waters in North America, with the exception of the lower Yellowstone River in Montana. Sturgeon in the lower Yellowstone average nearly the same size as those in the Missouri. The reason for these larger sturgeon sizes in the Missouri and Yellowstone is unknown.

Fishing for shovelnose in the Missouri is best from mid-May through September. Catch rates are highest in the lower few miles of the Marias River and in the Missouri from Loma Ferry to Coal Banks Landing. Some good catches are also taken between Coal Banks Landing and Fred Robinson Bridge, particularly during the warmer months.

Shovelnose have a prehensile, suckerlike mouth adapted largely for bottom feeding. For this reason, they are usually caught on live bait such as worms or night crawlers, and in deeper riffles with moderate current rather than in slow, stagnant pools. They are sometimes caught on setlines along with channel catfish or other fishes. The flesh is delicious and is usually prepared by deep-fat frying, broiling, or smoking. When cleaning the sturgeon, trim away the red-colored meat because it is oily.

Channel Catfish

The channel catfish is easily distinguished from other popular sport fishes in the Missouri by its smooth, scaleless body; eight long, fleshy barbels—or "whiskers"—on its head; and strong, sharp spines in each pectoral fin. The tail of the channel catfish is deeply forked, setting it apart from other Montana members of the catfish family. Most catfish anglers have been stung or pricked by the pectoral spine of this fish. The sting is caused by a gland beneath the skin near the fin that excretes poison; the sting is like a bee sting, and while it can be painful, it is not dangerous. It can be avoided by careful handling.

Channel catfish are widespread in the United States, in larger warm water rivers with clean bottoms of sand and gravel. They are abundant in the Missouri from the confluence of the Marias River to Fort Peck Reservoir. During spawning, they are also common in the lower reaches of the Marias, Judith, and Teton rivers.

Channel catfish spawn in the Missouri River and its tributaries from early June through August, when water temperature ranges from about 66°F to 78°F. They select secure spots, such as deeply undercut banks, hollow logs, or crevices in debris piles. After the female deposits her gelatinous mass of eggs, the male drives her away and he guards and tends the eggs and fry. Hatching occurs in six to 10 days, and the fry disperse about five days later. Channel catfish are highly migratory during spawning, and movements of 100 to 150 miles are common in this reach of the Missouri.

Channel catfish reach about seven inches after their first year of life in the Missouri. They grow two to three inches in length each year until they are about 6 years old, and an average of about an inch each year after that. Their growth rate is similar to those reported in other waters in the northern United States, but somewhat slower than in the southern states. Catfish up to 18 years old have been collected in the Missouri. The largest we took was 36 inches long, weighed 26 pounds, and was 17 years old.

Channel catfish are omnivorous, feeding on almost any kind of living or dead organism—aquatic insects, snails, worms, fish, seeds, berries, and many other items.

Because they are nocturnal and relatively inactive in daylight, fishing is best in the early morning, late evening, or at night. Midday fishing is best in deep holes below riffles or in shaded, protected areas such as under drift piles or overhanging banks. As darkness sets in, catfish move into shallow water and their feeding increases. Good catches are often taken

on setlines left overnight in the river. They can be taken on almost any conceivable bait, but favorites on the Missouri include worms, cut baits, and cheese—the smellier, the better.

Fishing for catfish in the Missouri and its tributaries is best during the spawning period in June, July, and August. The best catches are taken in the lower Marias, Teton, and Judith rivers and in the Missouri around the confluences of those streams. However, good catches are also taken throughout the entire length of the Missouri between the Marias River and Fort Peck Reservoir. From early September through May, many catfish move to the lower reach of the Missouri near its confluence with Fort Peck Reservoir, and catch rates in upstream areas drop off considerably. Catfish are excellent eating, particularly when deep-fat fried or broiled.

BOB COONEY

The section of the Missouri River below Eagle Creek deserves its classification as Wild and Scenic; its recreational, historic, scenic, and natural values are exceptional.

Burbot

Burbot, also called ling, are common throughout the entire length of the Missouri River between Morony Dam and Fort Peck Reservoir. However, they are less abundant than sauger, catfish, or sturgeon. The burbot is characterized by its long eel-like body, small head and eyes, a single chin barbel, and long anal and dorsal fins. They are found primarily in large rivers and cold lakes and reservoirs.

They spawn in winter, usually over a sand or gravel bottom, in water one to 10 feet deep, and at night. Males and females collect in masses, or "balls," releasing eggs and sperm. Fertilized eggs sink to the bottom and hatch in April or May. Although spawning areas for burbot in the Missouri are not well identified, creel survey and tag return evidence suggests most spawning occurs in a 30-mile reach between Morony Dam and Fort Benton.

We did not study growth rates and ages of burbot for the Missouri. However, studies on other rivers indicate burbot live at least 10 years, may grow to 42 inches long, and weigh 26 pounds. During our Missouri study, we collected burbot measuring 31 inches long and weighing 5½ pounds.

Voracious feeders, burbot consume fishes, aquatic insects, snails, crayfish, and almost any other available aquatic organism. They often feed at night and are more active in winter than in summer.

Fishing for burbot in deep holes below riffles seems to produce the best results. A 30-mile reach between Morony Dam and Fort Benton offers the best catches. Fishermen take them on a variety of baits, but cut-up chunks or strips of fish seem to produce the best results. They are sometimes taken along with channel catfish on setlines left overnight in the river. The flesh of burbot is excellent, and it is usually prepared by pan- or deep-fat frying.

Paddlefish

Like the shovelnose sturgeon, the paddlefish is a relatively primitive species. The appearance is un-

mistakable: a long, paddle-shaped snout; a wide mouth; a long, tapered gill flap; and an upturned tail. At one time, they were common throughout much of the Mississippi/Missouri River system. However, during the last 100 years, their numbers have declined considerably. Only six major self-sustaining paddlefish populations remain in the United States, including this one. The paddlefish is officially listed as a Species of Special Concern—Class "A" in Montana and is considered threatened nationally.

a sticky coating forms on the eggs, allowing them to adhere to rocks and pebbles where they incubate until hatching seven to 10 days later.

Newly hatched paddlefish drift downstream into Fort Peck Reservoir where they reside until they are mature. They do not reach sexual maturity until they are quite old, 7 to 8 years for males, and 12 to 14 for females. Paddlefish collected in the Missouri ranged from 6 to 29 years old, with the majority between 11 and 23 years old. Greater numbers of older paddlefish are found in the

rod, a heavy-duty reel, and a 50-lb.-test line with one or two large treble hooks and a heavy sinker near the end.

The best catches of paddlefish are taken on the Missouri from the middle of April through the middle of June, with the peak catch rates in May. Fishermen concentrate in a 17-mile reach of the Missouri between Fred Robinson Bridge and Fort Peck Reservoir on the Charles M. Russell National Wildlife Refuge. Dirt roads parallel much of this reach of river and provide easy access. Paddlefish

GEORGE WUERTHNER

The last major free-flowing and unaltered portion of the Missouri is home to a multitude of wild creatures, including these pelicans feeding from a gravel bar.

Paddlefish are found in the Missouri River upstream from Fort Peck Reservoir, from about mid-April through July. They migrate from Fort Peck Reservoir into the Missouri to spawn. Electrofishing surveys have documented spawning movements as far upstream as the confluence of the Marias River—150 miles.

Paddlefish spawn in the Missouri when water temperatures range from 58 °F to 68 °F. At least 14,000 cubic feet per second of water in the river is required for paddlefish to reach nine critical spawning sites identified by our research. They spawn on large, silt-free gravel bars with moderate or swift current, usually at a depth of more than four feet. One or more males accompany each female that has attained reproductive readiness. When the female begins to release her eggs over the spawning site, the males position themselves beside her and release clouds of milt to fertilize the eggs. Immediately after fertilization,

Missouri River population than in populations elsewhere in the United States. The relatively light fisherman harvest on the Missouri accounts, in part, for the large number of older fish. Since fishermen select for larger fish, as fishing pressure increases, more of the older paddlefish are harvested. The average size of paddlefish in the Missouri is also significantly larger than in other waters in the United States. Paddlefish harvested in the Missouri average 50 to 60 pounds, and quite a few weighing more than 100 pounds are caught each year. The Missouri has more trophy-sized paddlefish than anywhere else in the country.

Paddlefish feed primarily on organic debris and plankton. They swim through the water with their mouths open and strain out food with a highly developed gill raker system. Because of its unusual feeding adaptation, the only reliable way to catch a paddlefish is by snagging. The typical snagging rig consists of a stiff

are taken by fishermen from both shore and boat.

Paddlefish flesh provides excellent eating and is usually prepared by deep-fat frying, broiling, or smoking. When cleaning the fish, trim away the reddish meat because it is oily; keep only the white portion for eating. (For more information on the Missouri paddlefish population, see "Spoonbill," by Rod Berg, *Montana Outdoors,* March/April 1980.)

Epilogue

They're gone now, the early explorers and military forts, the trappers and gold seekers, the keelboats and the homesteaders, the steamboats and the river men. Their era has passed. But left behind as a tribute is the Wild and Scenic Missouri River, a crown jewel in the nation's Wild and Scenic River System. ■

● For another Missouri River story, turn to Rod Berg's Article, "Where Nature Reigns Supreme," headlining this issue's "The Catchall" section on page 11. — Ed.

Where Nature Reigns Supreme by Rod Berg

The Missouri is unique among rivers. I think God wished to teach the beauty of a virile soul fighting its way toward peace and His precept was the Missouri....And in it all the unwearying urge of a purpose, the unswerving belief in peace of a far away ocean.
—"The River and I," John G. Neihardt (1910)

I had risen with the sun on this late April day in 1976. The year remains etched in my memory, undoubtedly because it was our nation's Bicentennial. This particular day also would be remembered for other reasons as yet unrevealed to me.

Jim and I had been floating on the Missouri River for six days. We departed from Fort Benton, an unpretentious little town nestled on the river roughly a hundred miles upstream from where we were now camped at Dauphine Rapids. Stafford Ferry, still used occasionally to transport travelers across the Missouri, was situated a few hundred yards upriver from our camp. It was the only sign of humanity. Ferryboats outnumbered bridges in this remote and rugged section of river, and there were few of either. By October, the reach of river Jim and I had been floating would officially be designated as part of the National Wild and Scenic Rivers System. In total, a 149-mile segment of the Missouri from Fort Benton to the Fred Robinson Bridge would be declared Wild and Scenic because of its exceptional recreational, historic, scenic, and natural values.

I had worked for two years as a fisheries biologist for the Department of Fish, Wildlife and Parks on the upper Yellowstone, one of Montana's nationally famous trout rivers. I had moved to Fort Benton only a few months earlier to begin a fishery survey of a 207-mile free-flowing segment of the Missouri River between Great Falls and Fort Peck Reservoir. The Wild and Scenic section encompasses roughly the lower three-quarters of this reach. Little was known about the fishery in this segment of the Missouri, so I looked forward to the opportunity of uncovering the secrets of the river with enthusiasm similar to that of the early explorers who discovered this extraordinary place. Jim Albers, a fisheries fieldworker, would assist me in this venture. Jim and I had spent the previous month and a half equipping our boat with electrofishing apparatus designed to sample and monitor fish in the river, but this was our first field trip.

As I stepped outside our tent, the first rays of morning sunlight filtered over the barren, multicolored badland escarpments in the background east of Stafford Ferry. The morning air felt invigorating, and I sensed this would be a special day. As we prepared and ate breakfast, Jim and I were serenaded by the local musicians—meadowlarks, robins, mountain bluebirds, and others—holding forth in the meadow behind our camp. The bright green grass of the river bottomland was sprinkled with wildflowers, and the shiny new leaves on the cottonwood trees fluttered in a gentle morning breeze. It was springtime in north central Montana, and the Missouri River only a hundred yards away was beginning to rise, rejuvenated by early spring rains and snowmelt.

After breaking camp and loading our gear, Jim and I eased our boat into the Missouri's cold, murky waters. As we floated away, our morning serenade was triumphantly topped off with a grand finale from a flock of about 30 geese directly overhead.

Dauphine Rapids was becoming more roily this time of year. This rapids and several others on this reach of the Missouri represented difficult obstacles for steamboats to negotiate during their era a century ago. The steamboat Peter Belen *had wrecked here in 1869. The rapids was named, perhaps rather dubiously, for Louis Dauphine, a famous western hunter and guide, who fell into the river here while accompanying the European Prince Maximilian and Swiss artist Karl Bodmer on their 1833 keelboat expedition to Fort McKenzie. One cannot think of the Missouri's past without remembering the hundreds of brilliant sketches and paintings by Bodmer which captured the richness of the wild Missouri.*

After we had successfully negotiated the rapids, I reached forward from my position behind the steering wheel to start the portable generator which powered the electrofishing system on our boat. Jim took his position behind a railing at the bow and began to collect fish held momentarily in the electrical field created by droppers which dangled in the water a few feet ahead of the boat.

Over the past few days, we had discovered the rich diversity of the river's fishery. We captured sauger, shovelnose sturgeon, burbot, channel catfish, and numerous other kinds of fish. We identified, measured, weighed, and released them. We collected a few scales or pectoral fin rays from some to determine age and growth rates. We also tagged some fish with individually numbered plastic tags to assess fisherman harvest and fish movement. I was impressed by the variety of fish found here, compared with my previous experiences on trout streams, but as yet no particular fish really stood out from the crowd—nothing to leave a deep impression on my memory. Soon a dramatic encounter would change all of that.

As we floated downstream, my river map showed the location of a campsite occupied May 27-28, 1805, by Meriwether Lewis and William Clark, undeniably the most famous of the Missouri's early explorers. Jim collected a few more sturgeon, a couple of sauger, and a variety of suckers and minnows as we drifted through Lone Pine and Castle Bluff rapids and past Sturgeon Island. I recall being impressed at the aptness of the names of the landmarks along the river.

We had traveled for nearly 20 miles when we rounded a bend in the river near Bullwhacker Creek. An abandoned log homestead had been the day's only reminder of man's presence on the river. I began to sense the emotions felt by Prince Maximilian in 1833, when he described the Missouri as a "vast solitary wilderness, where Nature, in all her savage grandeur, reigned supreme." I wonder if the noble prince could have imagined that his words would capture the imagination of a traveler on this river almost 150 years later.

A few more miles downriver, we drifted past Cow Island, a famous historical landmark on the river. Because of the wide channel and shallow water near it, many boats were unable to proceed above this point during low water. Steamboats often unloaded their cargo at a landing here. The site also marks the point where Chief Joseph's band of Nez Perce crossed the

Missouri in 1877, fleeing the U.S. Army and seeking the safety of the Canadian border. The Indians raided a stockpile of Army supplies and equipment at Cow Island Landing before continuing up Cow Creek Canyon on the north side of the river. You can still see rifle pits occupied by a handful of soldiers and a couple of civilians who attempted unsuccessfully to protect the supplies and ward off the Indians. Chief Joseph's remarkable 1,300-mile fighting retreat from the Army eventually ended with his surrender to Gen. Nelson Miles in the Bear Paw Mountains about 50 miles north of the Missouri.

It was late afternoon as we drifted through some shallow water about a mile below Cow Island. Jim was at the helm, expertly guiding the boat through a riffle toward a deep pool. I stood on the bow with a net in hand, ready to collect fish entering the electrofishing field. As we entered the pool, the turbid water suddenly began to upwell and boil in a manner which usually foretold the rising of a large fish from the depths of the river to its surface. (Farther upriver, the roily upwelling usually preceded the appearance of a large sturgeon or bigmouth buffalo. Often weighing 10 to 15 pounds, these were the largest fish we had encountered on our trip.)

But this upwelling seemed much more immense than those I remembered from upstream encounters. I braced myself on the railing, anticipating that I might catch the largest fish of the day. Jim and I were competing for the biggest "catch"; the winner would relax that evening, while the sorry loser cooked dinner. Suddenly, the surface of the water was broken by a giant from the depths.

I don't frighten easily, but I must admit at that moment I was a bit startled. A monstrous, glistening black fish leaped from the water as though it were lashing out with every ounce of its strength against an unknown adversary. Spray flew everywhere as the fish danced across the water on its tail, its head held resolutely toward the sky. With its elongated snout, it resembled a swordfish. But as the black giant turned its head menacingly in our direction, I quickly realized we had met the Missouri's unique and unusual inhabitant, the paddlefish.

Nothing I had experienced previously as a biologist could have prepared me for the enormous size or strength of this fish. As suddenly as it had appeared, the giant spoonbill returned in a cloud of foam to its underwater domain. Leaving a huge wake on the surface, the paddlefish rapidly pulled away from our boat to the security of deeper water.

I dubbed this paddlefish "Blackie" because of her distinctive jet-black color—other paddlefish were greyish-black or bluish-black. Her deep, glistening black separated her from the crowd like a crown of jewels distinguishes a queen. It was as though Blackie wanted to be the first spoonbill in the river to let us know we had entered paddlefish domain. Ironically, we would electrofish more than a thousand paddlefish in our five-year study of the Missouri, but this particular paddler would be the largest we would encounter. We also captured and tagged many paddlefish, the largest weighing 126 pounds. I believe old Blackie probably weighed about 150 pounds. I know Blackie was a lady because paddlefish larger than a hundred pounds are invariably females.

I encountered Blackie twice in future years on the Missouri, both times in the same pool below Cow Island. I never got as close to her as I had the first time; she had become far too wise for that. She rose from the water at a safe distance from the boat, maybe to let me know she was still there. I often think Blackie may have stationed herself below Cow Island each spring to guide younger paddlefish past the shallow riffles around the island and to give them directions for reaching upstream spawning areas.

After five years of research on the Missouri, we would sample more than 90,000 fish. Blackie will always stand out from the others. To me, she was the matriarch of the Missouri, the supreme ruler of her domain. I often wonder if Blackie is still there—I don't know the answer, but I like to think she is. I'm sure no man could have captured her because she symbolizes that element in nature which transcends man's ability for conquest.

Jim and I completed our first expedition on the Missouri the next day. As we pulled out of the river at Fred Robinson Bridge, I felt good about everything I had learned and experienced. Yet I also was humbled by the magnificence of what I had seen. I will always remember old Blackie and the days I spent on the Wild and Scenic Missouri—days spent in a place "where Nature, in all her savage grandeur, reigned supreme."

* * * * *

•Turn to page 6 for Rod Berg's article, "Managing Fish on the 'Mighty Mo'."—Ed.

TU Honors Peterman

Larry Peterman, water resources supervisor for the Department of Fish, Wildlife and Parks in Helena, received the 1985 Mancinelli Award from the Missouri River Chapter of Trout Unlimited (TU).

The award, named after the late Steve Mancinelli, a former member of TU's Missouri River Chapter in Helena, is presented annually to an individual who "exhibits outstanding service toward the preservation and enhancement of trout fisheries."

In announcing the award, the chapter noted that Peterman "pioneered both the equipment development and the instream flow technology crucial to the preservation of our streams. In essence, at the technical level, this man wrote the book."

Peterman earned degrees from Wisconsin State University and Montana State University before joining the department in 1972. In his 13 years with the department, the award announcement continued, Peterman managed projects that quantified instream flow requirements of the Wild and Scenic section of the lower Missouri River, directed studies on the Missouri from Great Falls to Holter Dam, addressed fishing issues from Holter Dam to Townsend, and developed the master plan for filing and procuring instream water rights across the state.

Peterman's award was presented at the chapter's annual banquet, conducted in May.

Summer Courses in Yellowstone

A variety of special field courses in natural history, wildlife, and earth sciences will be offered in Yellowstone National Park this summer. The courses are offered by the Yellowstone Institute, under sponsorship of the Yellowstone Library & Museum Association.

Course offerings include: edible, poisonous, and medicinal plants; the birds of Yellowstone; astronomical phenomena in Yellowstone; grizzly bear biology, ecology, and management; the natural history of beaver ponds and marshes; the lakes of Yellowstone by canoe; backcountry photography; wilderness horsepacking, and many others.

A total of 37 classes will be offered; some began as early as June 1, but others will continue into September. Most classes

headquarter in rustic cabins overlooking the scenic Lamar Valley. For details on dates, fees, and a free course catalog, contact: the Yellowstone Library & Museum Association, P.O. Box 117; Yellowstone National Park, WY 82190 (307/334-7381, Ext. 2349).

Comments Sought On Department Plan

Review copies of "Design for Tomorrow," a comprehensive strategic plan for 1985-89, are available from Department of Fish, Wildlife and Parks regional offices, or department headquarters in Helena (1420 E. Sixth; Helena, MT 59620).

The plan spells out goals and objectives (statewide and regional) for all elements of the department's fish, wildlife, and parks programs. Public comment on the plan will be accepted until July 30, 1985. A summary of the public input received will be presented at the August 1985 Fish and Game Commission meeting.

New Legislation Affects Sportsmen, Recreationists

Although the 1985 Montana Legislature passed several bills that still have to be signed by the governor before they become law, a number of those already signed should be of interest to sportsmen and other recreationists.

One of the most significant and talked-about bills introduced into the 49th legislative session was House Bill (HB) 265, commonly called the compromise stream access bill. This bill, which became law when it was signed by the governor on April 19, addresses the rights and responsibilities of recreationists as they relate to the recreational use of our rivers and streams.

Because of the importance of this new law to both landowners and recreationists, the Department of Fish, Wildlife and Parks has produced an informational brochure that helps explain ways in which the new law affects these citizen groups. Free copies are available from Fish, Wildlife and Parks regional offices, from most license dealers, or by contacting the department's Conservation Education Division (1420 E. Sixth Ave.; Helena, MT 59620, or calling 406/444-2535).

Another new law that affects both landowners and recreationists resulted from passage of HB 911, which addressed trespass on private lands. This new law, which took effect when the governor signed it, states that a member of the public has the privilege to enter or remain on private land by the explicit permission of the landowner or his agent or by the failure of the landowner to post notice denying entry onto the land. The landowner may revoke the permission by personal communication.

The law states that notice denying entry must consist of written notice or of notice by painting a post, structure, or natural object with at least 50 square inches of fluorescent orange paint. In the case of a metal fence post, the entire post must be painted. This notice must be placed at each outer gate and normal points of access to the property and wherever a stream crosses an outer boundary line.

The law also extends the authority of game wardens to enforce the criminal mischief, criminal trespass, and litter laws to any private lands used by the public for recreational purposes.

Other bills of interest to sportsmen passed by the Legislature and subsequently signed into law include:

- Senate Bill (SB) 209—This law creates a fish and wildlife "crimestoppers" program within the Department of Fish, Wildlife and Parks as of July 1. Through the program, rewards would be offered to individuals who provide information that leads to the arrest and citation of game law violators in Montana. Individuals offering information will remain anonymous.
- SB 334—This law revises the income tax checkoff provision for supporting the state's nongame wildlife program by eliminating the limit taxpayers can contribute to the program and eliminating the provision that only those receiving tax refunds can contribute. Now all taxpayers will have an opportunity to contribute to the program when they file their state tax returns.
- HB 282—The new law will allow the department to auction one bighorn sheep permit annually, with proceeds to be used for bighorn sheep management.
- HB 406—This law will increase cost of a resident fishing license by $1, cost of a non-resident two-day fishing license by $2, non-resident season fishing license by $5, non-resident paddlefish license by $7, resident sportsman's license by $1, and the non-resident combination license by $50. These fee changes will take effect March 1, 1986.
- HB 680—This new law, which takes effect July 1, revises the state's current water management policy to maximize the state's interests in the interstate allocation of water, provides priority dates for water reservations in the Missouri River Basin, and amends the current criteria for water appropriations.
- HB 692—This law, which also takes effect July 1, creates a new youth trapping license that youngsters between the ages of 6 and 14 must obtain to trap mink and muskrat. They will not, however, be permitted to trap beaver, bobcat, lynx, otter, wolverine, or fishers with this new license.
- HB 763—The law gives the department authority to conduct regulated hunts for bison (buffalo) within the state and provides the Fish and Game Commission with authority to set licensing procedures for the hunts.
- HB 764—This new law, as of Oct. 1, will allow disabled hunters, as certified by the department, to hunt and shoot from vehicles or the shoulder of certain public roads.
- HB 820—The law will require that persons hunting waterfowl in Montana after March 1, 1986, possess a state waterfowl stamp while hunting. Proceeds from sale of these stamps will be used to protect, develop, and enhance wetland areas in the state.

BOOK REVIEW

FRESHWATER WILDERNESS: YELLOWSTONE FISHES & THEIR WORLD, by John D. Varley and Paul Schullery, the Yellowstone Library & Museum Association, P.O. Box 117, Yellowstone National Park, WY 82190; 1983, 132 pages, $19.95, hard cover; $12.95, soft cover.

As authors Varley and Schullery say in the introduction, "This book is both a celebration of Yellowstone's aquatic treasures and an expression of hope for their future." Beautifully illustrated by Michael Simon, the book is divided into three major sections.

The first, "The World of Yellowstone Fishes," describes the physical features of Yellowstone's waters, traces their geological origins, and documents the changes, both natural and man-induced, that have taken place over the years.

The second part, "Yellowstone Fishes Described," begins with a delightful essay called "On Being a Fish" (reprinted in this issue on page 33), and goes on to detail the characteristics, distribution, habitat, and life history of each fish species, both native and introduced.

The third part, "Yellowstone Fishes in the Mind of Man," records the history of fish introductions and early fishing in the park, and documents the evolution of fisheries policy in Yellowstone. A chapter in this section is also devoted to fishing and fishing tackle.

If you are looking for a "how-to" book on catching fish in Yellowstone, other books may offer more advice. But if your curiosity extends to learning more about the ecological relationships among Yellowstone's waters and their fishes, you will find "Freshwater Wilderness" a valuable and readable reference on the subject.—*Dave Books, editor*

CONTRIBUTORS

• One of the two articles **Rod Berg** has written about the Missouri River for this issue begins with a quote: "The Missouri is unique among rivers." Everything in the two pieces backs up that statement. In "Managing Fish on the 'Mighty Mo' " (page 6), Berg notes the 207-mile reach from Great Falls to Fort Peck Reservoir is the last major free-flowing and unaltered portion of the Missouri; as he writes, "The free-flowing river, protected as part of the National Wild and Scenic Rivers System, preserves not only scenery, solitude, and recreational opportunities, but also a bountiful fish and wildlife resource." "Where Nature Reigns Supreme" also describes the Missouri. It begins this issue's "The Catchall" on page 11, and it's about a fish that was—and is—a symbol of the wild, free river. Berg is project coordinator for the department's fishery studies on a 120-mile reach of the middle Clark Fork in west central Montana. He conducted fishery inventory and planning on the blue ribbon stretch of the upper Yellowstone, and on 350 miles of the Missouri, from the Helena area to Fort Peck Reservoir.

• **Brad Shepard**'s article opens with the statement, "Northwestern Montana offers some fine lake and reservoir fishing." No arguments there—most Montanans and many out-of-state visitors know about lakes such as Whitefish, Flathead, Ashley, and others. But there's a body of water that is a newcomer in two respects: First, the body of water itself is relatively new because it's Lake Koocanusa, the reservoir formed when Libby Dam was built; second, there's a newcomer to the reservoir—kokanee. Anglers first began catching kokanee in Koocanusa in summer of 1981 and now, as Shepard notes, anglers often catch their limit of 20 kokanee per day. Shepard is a department fisheries biologist working on a Bonneville Power Administration project in Libby. Turn to "Kokanee in Lake Koocanusa: Silver from the North" on page 15.

• "The water quality and quantity, streambank cover, and streambed integrity of Montana's thousands of miles of rivers and streams provide ideal trout habitat and sustain one of the finest wild trout resources in the world." In Montana, "Wild Trout Management" involves a "Commitment to Excellence." For the story of how the department came to manage for wild trout—complete with controversy, wild public meetings, and a polarized fishing public—turn to **Jerry Wells**' article on page 19. Wells is the fisheries manager for Region 3 (Bozeman).

• A hot August afternoon—and Canyon Ferry Reservoir is deserted. **Loren Bahls** tells you why: "Those Bloomin' Algae." In 1984, the reservoir was hit with a bloom of toxic algae that turned parts of it into something that resembled pea soup—and cattle which drank the water died. As Bahls points out, toxic strains of algae are rare, but there's no way to predict when and where they will appear. Surface water must warm to at least 68°F before a bloom can occur, which explains why they appear only in summer and often begin in shallow bays where water is quickly warmed by the sun. Factors that turn non-toxic strains into toxic strains are unknown. Bahls is supervisor of the Water Quality Bureau, Department of Health and Environmental Sciences. He is a student of diatoms and of algae, and was president of the Montana Academy of Sciences in 1983-84. Turn to his article on page 24.

• In 1924, **Mary Dawe Lowry** lived at "Kozy Kove" in Yellowstone National Park, worked as a "pillow puncher," and some of her closest friends were "Pack Rats." In 1983, **Denise Mackesy** lived in Juniper (called "Jupiter" by its inhabitants because of the noise level), worked at "McMammoth's," and became a "W.I.T."—Wrangler-In-Training. Even though Lowry is from eastern Montana and Mackesy from New York—and even though nearly 60 years separate their "Yellowstone Summers"—they share the belief that it was a wonderful experience, a good preparation "for the more serious business of living." Turn to "Working in Yellowstone: Then and Now" on page 27. Lowry lives in Savage, Mont., and continues to enjoy writing about her family and Montana experiences. Mackesy is activities director for a nursing home in Santa Barbara, Calif.

• When Lewis and Clark visited the headwaters of the Missouri River in 1805, they found abundant wildlife and beautiful scenery. Modern visitors to Missouri Headwaters State Park find "Unfolding History" through the many interpretive displays, plus other attractions such as grassy picnic spots. Turn to **Doug Monger**'s article and photographs on page 31. Monger is the parks manager for Region 7 (Miles City).

• **John D. Varley** and **Paul Schullery** wrote a book called "Freshwater Wilderness: Yellowstone Fishes & Their World" (reviewed on page 13). A chapter from that book will titillate your contemplation: "On Being a Fish." For example, if you were a fish, you would move through the water as you would "were your legs tied together and your arms tied at your side. You move by 'waving' your entire body." Varley is research administrator in Yellowstone National Park; previously he was assistant project leader of the U.S. Fish and Wildlife Service's fisheries research team in Yellowstone. Schullery is a writer who lives in Livingston; he has written, coauthored, or edited nine books, among them "Old Yellowstone Days" and "Mountain Time." Their essay begins on page 32, and continues *Montana Outdoors*' "Perspectives."

• **Robert Spannring**'s illustration for "On Being a Fish" is one more reason to make sure you don't miss it. Spannring's work has appeared many times in our pages; each piece is a jewel, and the one in this issue is as apt as it could be. In addition to watercolor and pen and ink, Spannring has expanded into silkscreen printmaking, acrylics, and oils. He notes that he and his wife have opened their own serigraphy shop. For additional information about his work, contact him at P.O. Box 1055; Livingston, MT 59047 (406/222-0404.)

• Thousands of mountain lakes dot Montana's wilderness areas, with several thousand miles of wilderness streams coursing through the backcountry. **John Fraley** writes that half of the visitors to Montana's wilderness areas enjoy fishing. However, with rising use of wilderness waters, questions about management have also risen. In "Montana's Wilderness Fishery: Should We Manage It, Or Leave It Alone?" Fraley looks at some of the management problems, and offers some suggestions on how to solve them. He is the department's manager for the Bonneville Power Administration's fisheries studies; since 1972, he has made over 100 visits to Montana's wilderness areas for backpacking, fishing, hunting, and cross-country skiing. His article begins on page 34.

• Special thanks to the following photographers for their contributions to this issue: **Bob Cooney, George Lane,** and **Sean Logan,** Helena; **Gordon Dietzman,** Madison, Wis.; **Gary D. Holmes,** Lolo; **Nelson Kenter** and **George Wuerthner,** Missoula; **Tim Lucas,** Denver; **Neal Mishler,** Great Falls; **Jack and Lori Oelfke,** West Glacier; and **Joyce Clark Turvey,** East Glacier.

Kokanee in Lake Koocanusa:

SILVER FROM THE NORTH

by Brad Shepard

Kokanee, sometimes called silver salmon, were first caught in Lake Koocanusa in 1981.

photos: MIKE ADERHOLD

Northwestern Montana offers some fine lake and reservoir fishing. Lakes such as Flathead, Whitefish, Ashley, and many others draw anglers from throughout the state and across the nation. A relative newcomer—although one of the most promising—is Lake Koocanusa, the reservoir behind Libby Dam on the Kootenai River.

Lake Koocanusa has recently been providing some of the state's best kokanee fishing, with anglers often catching their limit of 20 kokanee daily (40 in possession). This is a relatively recent phenomenon, and this article will present the reservoir's history and describe research efforts to protect and enhance its fishery. It will also take a look at kokanee in the reservoir, speculate on how they got there, and predict what anglers might expect in the future.

Before and After Lake Koocanusa

The Kootenai River drains slightly over 19,000 square miles of land in British Columbia, Montana, and Idaho. The drainage is unique because the river flows south out of British Columbia into Montana, west through the northwestern corner of Montana into Idaho, north through Idaho, and back into British Columbia where it enters Kootenay Lake. After leaving Kootenay Lake, it empties into the Columbia River near Castlegar, B.C. The Kootenai River is the second largest tributary to the Columbia River system, second only to the Snake River.

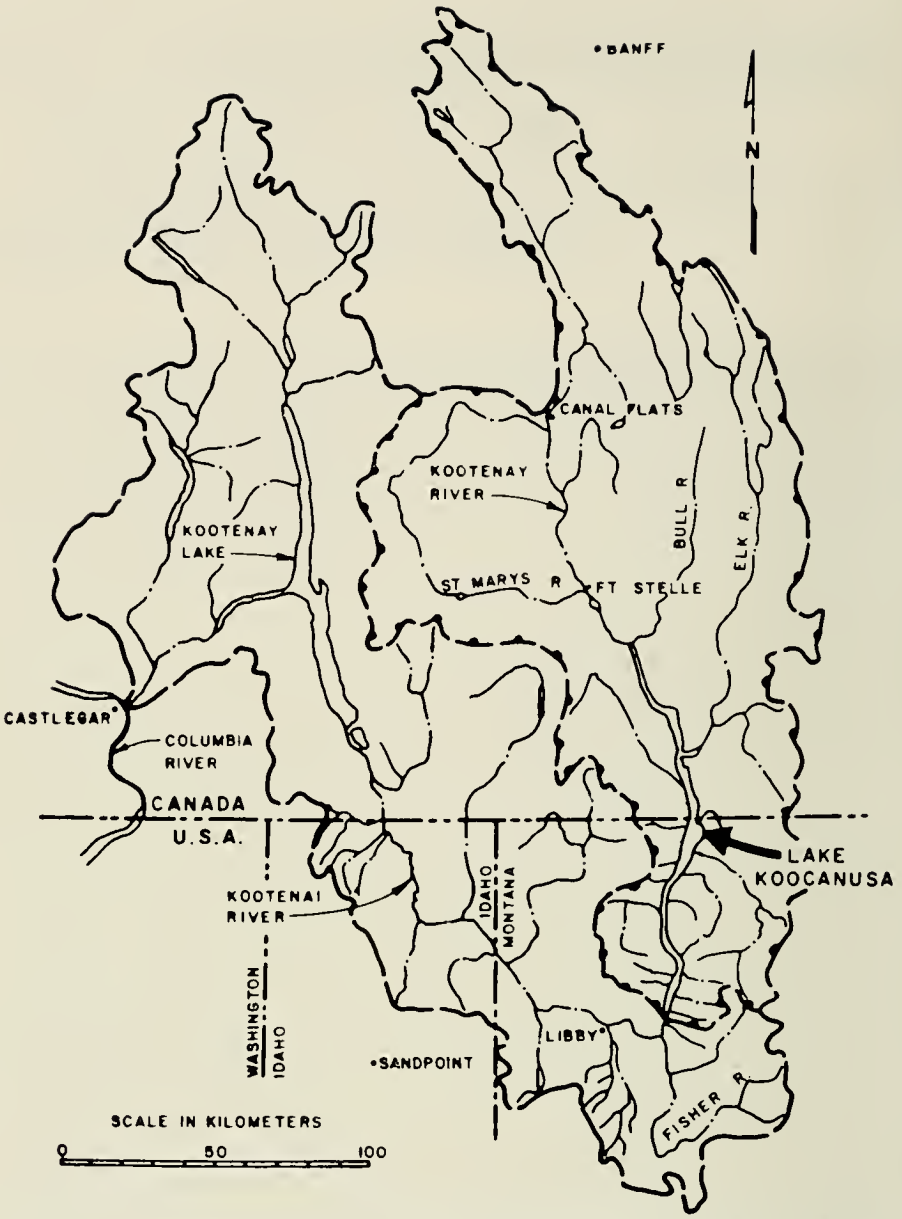
The U.S. Army Corps of Engineers (corps) began constructing Libby Dam in 1966. Water was first impounded in March 1972, and the

reservoir reached full pool in 1974. Libby Reservoir was officially named Lake Koocanusa—"Koo" from Kootenai, "can" from Canada, and "usa" from U.S.A. The reservoir fluctuates annually to provide hydroelectric power and flood protection. Since 1975, annual fluctuation has averaged 118 vertical feet; the maximum allowable fluctuation of 172 vertical feet has been reached only once, in 1975. The average drawdown reduces the reservoir's surface area by 51% and the reservoir's volume by 67%, while the maximum fluctuation reduces surface area by 69% and volume by 85%.

Before impoundment by Libby Dam and based on creel census, the Kootenai River supported cutthroat trout, mountain whitefish, rainbow trout, and bull trout in decreasing order of abundance. Pre-impoundment surveys found mountain whitefish to be the most abundant game fish in the river.

The Montana Department of Fish, Wildlife and Parks (DFWP) and the corps cooperatively selected the westslope cutthroat trout as the primary species for management in Lake Koocanusa because (1) it was a native trout species, (2) there was a readily available stock from Hungry Horse Reservoir which exhibited an ability to survive in a fluctuating reservoir environment, and (3) it could reproduce successfully in reservoir tributaries.

The corps funded department studies of development of the fishery within Lake Koocanusa from impoundment through 1982 and research to enhance production of westslope cutthroat trout in reservoir tributaries. The corps also provided funds to construct and operate a westslope cutthroat trout hatchery, Murray Springs Hatchery near Eureka, as partial mitigation for construction of Libby Dam. The hatchery was completed in 1980, and cutthroat trout from it first were released into Lake Koocanusa in 1981.



Lake Koocanusa and the Kootenai River drainage (reprinted from P.F. Woods and C.M. Falter, "Limnological Investigations: Lake Koocanusa, Mont.," Special Report 82-15, Part 4: Factors Controlling Primary Productivity, 1982)

Fish, and the "Power Planning Act"

In 1980, Congress passed the Pacific Northwest Electric Power Planning and Conservation Act. The act created the Northwest Power Planning Council and directed the council to "promptly develop and adopt a program to protect, mitigate and enhance fish and wildlife, including related spawning grounds and habitat, on the Columbia River and its tributaries." After reviewing recommendations from state and federal agencies, Indian tribes, and private utilities, the council developed a Fish and Wildlife Program, part of which addresses resident fish.

The DFWP recommended drawdown limits of 90 to 110 feet for the reservoir. When the department realized the reservoir would have to be drawn down farther to provide flood protection, an exception was recommended for years of extremely high precipitation. The department also recommended further study in Lake Koocanusa to identify the potential impacts of dam operation on the reservoir fishery. The objective of this research is to allow the DFWP to cooperatively develop (with Columbia River Basin water managers, hydroelectric project operators, other fish and wildlife management agencies, Indian tribes, and private utilities) a water management plan which allows for flood protection and a continued stable supply of hydroelectric power, while maintaining or enhancing the resident reservoir fishery.

The council adopted these recommendations and asked the Bonneville Power Administration to fund the proposed study. Department biologists began their work in May 1983, and they will continue to gather information until October 1986. A final report, including projected effects of alternative water management plans on the fishery of Lake Koocanusa, will be prepared by October 1987.

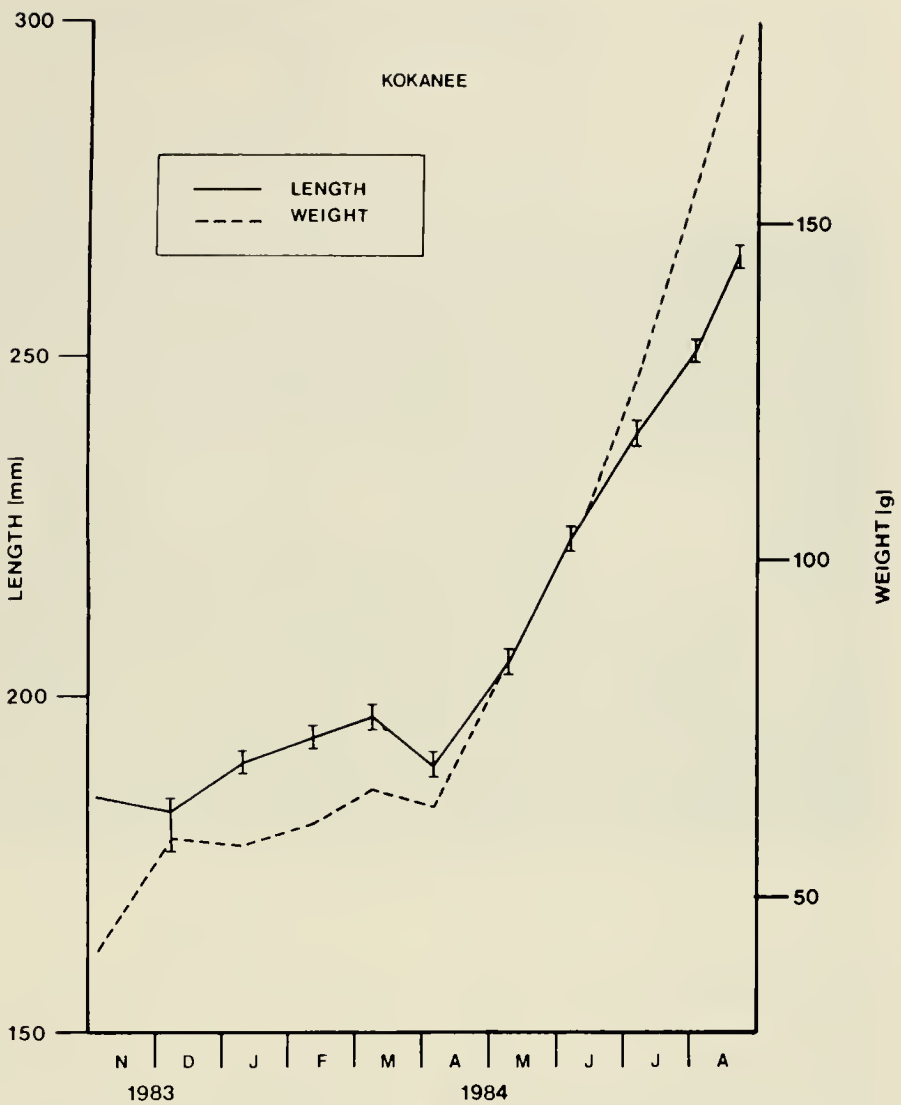
Kokanee in Koocanusa

The early years of angling in Lake Koocanusa were frustrating, but productive. Anglers had to contend with floating debris and stumps, difficult access, heavy winds, and ugly mud banks which prompted some anglers to call the reservoir "Who can use ya." However, those who were willing to put up with the inconvenience frequently returned with creels containing 16- to 20-inch cutthroat and an occasional rainbow in the 4- to 5-pound class.

In the late 1970s and early '80s, things began to change. The number of peamouth (moderately sized minnows) began to increase dramatically, while redside shiners (small minnows) decreased. The number of rainbow trout increased, although their average size declined, probably because of fewer redside shiners, a preferred food of large rainbow trout. Cutthroat trout numbers declined slightly, even though the DFWP had been releasing 200,000 to 500,000 cutthroat trout fry and fingerlings annually from Murray Springs Hatchery since 1981. However, the most notable change was the sudden appearance of kokanee.

Department fisheries biologists first captured kokanee, often called silver salmon, in Lake Koocanusa during sampling in fall 1979. These kokanee were large, mature fish, averaging 20 inches long. The question was: Where did they come from? Two potential sources were (1) Glen Lake in the Tobacco River drainage, or (2) British Columbia's Kootenay Trout Hatchery on Norbury Creek, a tributary to the Bull River.

Glen Lake is an irrigation reservoir with an outlet to Lick Creek, a Tobacco River tributary with limited flows. The Kootenay Trout Hatchery raises kokanee for release into British Columbia lakes. Water from the hatchery flows into Norbury Creek, a tributary to the Bull River. The Bull River enters Lake Koocanusa near Wardner, B.C.



The average monthly growth of the 1983 year-class of kokanee from November 1983 through August 1984. Vertical bars represent the 95% confidence intervals on mean lengths.

Adult kokanee migrated up the Bull River during fall of 1979, presumably to spawn. The presence of these spawners points to the Kootenay Trout Hatchery as the probable source of kokanee in Lake Koocanusa because salmonids (the family to which kokanee belong) return to their natal tributary (where they were born) to spawn. Canadian fishery workers admitted that a rearing pond containing approximately 30,000 kokanee fry may have accidentally been released into Norbury Creek in 1977.

Kokanee progeny from the spawn of 1979 would have emerged and entered the reservoir during 1980. In February 1981, more than 100 5- to 6-inch juvenile kokanee were found stranded on the banks of the Kootenai River below Libby Dam after a rapidly reduced outflow from the dam. Anglers in Lake Koocanusa first began catching these kokanee in the summer of 1981. At that time, they averaged 11 inches. During 1982, anglers in the reservoir caught a significant number of kokanee from 11 to 20 inches long.

Numerous mature kokanee (averaging 17 inches) were captured in netting conducted by the DFWP during fall 1982. These fish were 2

years old and had spent three growing seasons (summers) in Lake Koocanusa. During fall 1982, kokanee spawned in one U.S. tributary of Lake Koocanusa (the Tobacco River) and in several Canadian tributaries, including Kikomun Creek and Norbury Creek. Mature kokanee also were found in the upper Kootenay River drainage above Lake Koocanusa in British Columbia. The offspring from these adults comprise the 1983 year-class (the year in which fish hatch—comparable to birth year) which now resides in Lake Koocanusa.

STEVE WIRT

The U.S. Army Corps of Engineers began constructing Libby Dam in 1966. Water was first impounded in March 1972, and the reservoir—Lake Koocanusa—reached full pool in 1974.

Department fisheries biologists first captured members of the 1983 year-class in sampling conducted in fall 1983. These juveniles had grown to an average length of 7 inches after spending a single summer in Lake Koocanusa. During August 1984, biologists estimated that 2.5 million kokanee were in Lake Koocanusa. Over 98% of these were members of that 1983 year-class. The average length and weight was over 10 inches and 0.4 pounds.

Based on reservoir sampling, department biologists estimated that 35% of the males and 4% of the females were ripe and probably spawned during fall 1984. Information from kokanee spawn-taking stations operated by British Columbia fishery workers confirmed the nearly 10 males per female ratio found in the mature reservoir population. Applying this information to estimated numbers and sex ratios found for the kokanee population in the entire reservoir during August, an estimated 450,000 males and 50,000 females left the reservoir to spawn during fall 1984. That means approximately 2 million kokanee remained in the reservoir after fall.

In 1984, kokanee spawners averaged 12 inches in length, compared with the 16-inch average size reported during 1982. These 1984 spawners were 1+ fish—fish which spent two summers in the reservoir. Canadian fisheries biologists received reports of mature adult kokanee caught or observed throughout the upper Kootenay River Basin during fall 1984, pointing to the fact these kokanee are "pioneering" into new potential spawning habitat.

As these early maturing kokanee illustrate, kokanee have "plasticity"—the ability to adapt extremely rapidly to a change in their environment. The kokanee population in Lake Koocanusa has built up rapidly because the abundant food supply (in the form of zooplankton) allowed these fish to grow fast enough to reproduce after spending only two growing seasons in the lake. This early maturation phenomenon has been reported in other lakes immediately after the introduction of kokanee. The question is: How many fry will be produced from the 1984 spawning year to return to Lake Koocanusa in 1985?

Kokanee size depends on the density of kokanee in a particular body of water. As kokanee density increases, average size declines. As mentioned previously, kokanee reach 7 inches by the end of their first summer in the reservoir. Growth during the first winter is slow, averaging only 0.2 of an inch from November through April. From May through September, growth averages over 0.5 of an inch per month, then begins slowing again. Presently, biologists do not know how long these growth rates can be maintained in the presence of ever-increasing numbers of kokanee.

Kokanee vs. Trout

Fisheries biologists aren't certain about the impact of the kokanee population explosion on trout populations in Lake Koocanusa. After 1980, trout declined. The most likely competition between trout and kokanee is for zooplankton. Both trout and kokanee prefer Daphnia, a type of zooplankton often called "water flea." Trout eat Daphnia and other zooplankton during the winter, but will eat insects from the water's surface during spring, summer, and fall. Kokanee eat zooplankton almost exclusively year-round. Kokanee are more efficient in using zooplankton, in part because they have more tightly packed gill rakers which can filter out smaller zooplankton than trout can. Therefore, if kokanee eliminate larger zooplankton from the food base, less zooplankton will be available as trout food. The department study under way will enable fisheries biologists to document these effects and to monitor the kokanee population.

Lake Koocanusa was a popular ice fishing spot this past winter (1984-85) and anglers were very successful in catching kokanee. During the rest of the 1985 season, the kokanee fishery in Lake Koocanusa should be excellent, with nearly 2 million kokanee available, ranging from 11 to 15 inches long and weighing up to 1.5 pounds. Consider what Lake Koocanusa has to offer: silver-colored kokanee, a "gift" from the North. ■

BILL PRYOR

Wild Trout Management:

COMMITMENT TO EXCELLENCE

by Jerry Wells

It's summertime in Montana, and from Eureka to Red Lodge (and San Diego to Boston) anglers are thinking of Montana trout. The water quality and quantity, streambank cover, and streambed integrity of Montana's thousands of miles of rivers and streams provide ideal trout habitat and sustain one of the finest wild trout resources in the world. Each summer, anglers from throughout the country and abroad join Montanans in pursuit of wild trout.

Wild trout? What do we mean by "wild trout"? Perhaps the best place to begin to answer the question is out on your favorite trout stream. Take a good look at the next trout you catch. Hold the fish gently in your hands for a moment and look carefully at the perfectly formed fins and the subtle, yet striking, coloration. Then ask yourself a simple question: Where did that trout come from? Based on a recent survey of our fisherman's log holders—and much to our surprise—nearly half of the fishermen in Montana would answer that the trout came from a fish hatchery. In actuality, with few exceptions, the trout that inhabit the thousands of miles of streams and rivers in Montana are wild trout. That is to say, they are the progeny of wild trout parents that spent their entire lives from egg to adult in that stream system. Many of our trout streams haven't had a trout planted in them for over 20 years; since 1975, plants of hatchery trout in rivers and streams have become a rare event in Montana. Trout raised in our hatchery system today are planted almost exclusively in lakes and reservoirs.

The story of how we came to manage for wild trout in our rivers and streams is an interesting one. It involved many personalities both within the Department of Fish, Wildlife and Parks (DFWP) and from the wide array of Montana fishermen. The wild trout concept generated a great deal of controversy in the late 1960s and early '70s, polarized both department personnel and the fishing public, and resulted in several of the wildest public meetings this department has ever conducted. But most important, wild trout management has resulted in greater numbers of trout available to the angler in nearly all of the streams that previously received extensive plants of hatchery trout.

In the Beginning

To understand the evolution of trout management in Montana we must go back to the turn of the century. Before 1899, western Montana rivers and streams supported game fish populations of native cutthroat trout, grayling, and whitefish. Rainbow trout were found only in the northwestern corner of Montana where they are native to the Kootenai River system. In 1899, rainbow trout from the McCloud River drainage of California were introduced into Yellowstone National Park, which gave them access to the entire Missouri River drainage. In the following years, rainbow were planted in numerous other streams of the state. Brown trout, native to Europe, were introduced in the early 1900s to the upper Missouri River drainage and were planted extensively up to the early 1950s. Brook trout, native to the eastern United States, were introduced to many streams in the early 1900s.

The introduction of these three non-native species had calamitous effects on the native cutthroat and grayling populations in many parts of the state. Native cutthroat lost their genetic integrity through interbreeding with rainbow trout and disappeared from most of their historical range. Today, pure-strain westslope and Yellowstone cutthroat occupy less than 8% of their respective original ranges. Stream-dwelling grayling, once so numerous that they were harvested with pitchforks, exist today only in the upper Big Hole River.

Brook trout proliferated in hundreds of small streams; rainbow trout populated larger rivers and some streams, and brown trout did very well in the many rivers of western Montana. From the 1940s on, the river and stream trout fisheries of western Montana, with a few exceptions—such

as the Flathead River drainage where westslope cutthroat trout would hold on—would be made up of rainbow, brown, and brook trout. Of the original native species of salmonid game fish, only the whitefish proved able to coexist with the introduced species.

1908-55: Early Trout Management in Montana

Construction of the Anaconda hatchery in 1908 marked the beginning of Montana's efforts to propagate and introduce trout to the state. In the next 14 years, five more trout hatcheries (Somers, Emigrant, Lewistown, Great Falls, and Big Timber) were constructed. By 1922, Montana had six state fish hatcheries with the capability of raising large numbers of trout. Trout culture and distribution from 1908 to 1955 totally depended on existing wild trout populations created by earlier plants of rainbow and brown trout. Spawning traps were constructed and operated on tributary streams to Ennis Lake, Hebgen Reservoir, Willow Creek Reservoir, Georgetown Lake, and Rogers Lake to collect eggs from rainbow, brown, and brook trout and grayling.

Rainbow trout from these wild populations were the descendants of historic plants and represented the native, spring-spawning rainbow of California. From approximately 1910 through 1955, rainbow eggs were collected from existing wild runs in the spring, and fish raised to two to three inches in the hatcheries were planted in the fall. While it was not recognized by fisheries managers, wild, self-sustaining populations of rainbow had established themselves in many of the rivers and streams of western Montana by the 1940s. The famed trophy rainbow fishery of the Big Hole River that existed in the 1940s is but one example. Unaware that Montana's rivers and streams had everything that rainbow trout required to establish self-sustaining populations, fish managers continued to plant rainbow annually in most of these waters.

Brown and brook trout eggs from wild populations established by earlier plants were also collected, raised in state hatcheries, and planted extensively throughout the state. Brown trout proved to be highly successful in larger rivers, while brook trout thrived in smaller streams. By the late 1940s, both of these fall-spawning species had established reproducing populations throughout western and central Montana. Fish managers recognized the success of self-sustaining populations of both brook and brown trout, and propagation and planting ended in the early 1950s. Since then, brown and brook trout populations have been managed as wild trout fisheries.

1955-67: The Arlee Rainbow Broodstock

The year 1955 marked a radical change in rainbow trout management in Montana. The department had bought the Jocko River hatchery near Arlee in 1947, a purchase which included an existing domesticated broodstock from Washington, the fall-spawning Donaldson rainbow. The Donaldson strain was crossed with another fall-spawning domesticated rainbow strain from Missouri, and the progeny was christened the Arlee rainbow. The Arlee rainbow proved adaptable to hatchery conditions, and since 1958 has been used as the rainbow broodstock for Montana. Progeny from the domesticated Arlee rainbow quickly replaced the wild strains of rainbow that had provided the sole source of rainbow until 1958.

Initial reaction to creation of the Arlee rainbow was positive. Creation of a dependable broodstock eliminated the need to spend weeks trapping during wild spawning runs that varied in timing and numbers of fish from year to year. The fact that the Arlee fish spawned in late fall also meant that larger fish could be planted in the spring when chances for survival are greatest. Two- to three-inch progeny from the wild runs of rainbow had been planted in the fall when chances for survival were lower. Questions relating to how the domesticated Arlee would survive in the wild and whether it could successfully reproduce were raised by some fisheries workers, but answers were not available.

From the late 1950s through the early '70s, millions of Arlee rainbow were planted throughout Montana. The direction in fishery management shifted to plants of "catchable" rainbow (7 to 10 inches), and by the early 1960s, our finest wild trout streams were receiving massive plants of "catchables." The Madison River alone was planted with over 100,000 catchables annually by the early 1960s. Most of these came from a federal hatchery near Ennis. Human nature being what it is, fishermen were accustomed to seeing hatchery trucks plant the Madison and naturally associated catching trout with the hatchery.

It was also in the early 1960s that the policy of planting catchables in our finest wild trout rivers began to be questioned. Fisheries biologists were beginning to sample our rivers and streams with the aid of electrofishing. For the first time, biologists were able to get a clear picture of the trout populations in our streams—and what they found there were excellent populations of wild trout. Biologists also began to investigate the survival and return to the fisherman's creel of planted catchables. What they found was disturbing.

Over 70% of the catchables disappeared within four weeks of planting and 95% were gone within three months. Fishermen at best caught only 40% of the catchables and in many instances creeled less than 20%. This failure to survive in the wild meant that large hatchery rainbow were not available to the fisherman and that these planted trout had little chance to reproduce since they did not survive long enough to mature sexually.

Perceptive anglers, too, began questioning the "catchable" policy, complaining that their catch of larger trout decreased dramatically after its onset. Anglers and biologists alike began to openly question the wisdom of planting hatchery trout on top of existing wild trout populations. What effect did the hatchery trout have on wild fish? This question began to be hotly debated within the department, with one faction promoting the catchable policy as responsible for making fishing better and the other side contending that fishing was actually worse. Neither side had much in the way of hard evidence to prove its point. The general fishing public, raised on the premise that hatchery trout and trout fishing were inseparable, tended to favor the catchable program.

By 1966, Art Whitney, chief of the department's Fisheries Division, was publicly questioning the wisdom of the catchable program. In 1967, the department provided a list of the highest quality trout streams to the Montana

Fish and Game Commission with the proposal that they be managed for wild trout. The commission, faced with a public conditioned to view trout fishing as depending on hatchery trucks, and without scientific data to suggest that planting catchables had any adverse effect on wild trout populations, declined to accept the proposal.

1967-75: Research, Controversy And a Vision of the Future

In 1967, a research project that was to have enormous consequences for fishery management in Montana was initiated on the Madison River. The young biologist selected for the project was Dick Vincent. The project was supported by Fisheries Division Chief Whitney and Bud Gaffney, Vincent's boss and the regional fisheries manager in Region 3 (Bozeman). Others within the department, especially in the Hatchery Bureau, were understandably less than enthusiastic about the research.

TIM TOOAS

GEORGE WUERTHNER

Research, habitat preservation and, in some instances, special regulations, have all contributed to Montana's exemplary wild trout management program. The key to future success is continued streambank and streambed protection and maintenance of sufficient instream flows.

Vincent's task was to evaluate the effects of planting catchables on wild trout populations in the Madison River. Results of his landmark study were published in the May/-June 1972 issue of *Montana Outdoors* in an article titled "The Catchable Trout," written by Don Bianchi and illustrated by Vern Craig. Vincent's data made a convincing case for the adverse effects of planting catchables on top of wild trout populations. By using long-term stream study sections evaluated by electrofishing and by ceasing to plant catchables within the study area, Vincent documented vast

increases in numbers of wild trout after planting ceased. Of particular significance to fishermen was the dramatic increase in numbers of larger trout. Vincent also found that wild rainbow were suppressed more than brown trout, a phenomenon that was to be documented later in the Big Hole and Yellowstone rivers.

While the exact mechanism by which planting catchables adversely affects wild trout has not been determined, it undoubtedly revolves around behavioral differences. Wild trout live in harmony with their natural stream environment and establish a dominance hierarchy. Hatchery trout, on the other hand, live an unnatural life; artificially fed, they are crowded in raceways and lack room to establish such hierarchies. When planted in streams on top of wild trout populations, chaos results. Established territories are not respected, and wild trout must either expend energy to maintain their positions or give them up entirely. Displaced or stressed wild trout have considerably less chance for survival. Whatever the exact mechanism of interaction, the cessation of planting catchables had a dramatic effect on wild trout populations in the Madison River, and later the Big Hole and Yellowstone rivers.

Armed with Vincent's persuasive data, in 1972 the department proposed that planting be ceased on the Madison River. The proposal to eliminate a practice that seemed as American as apple pie created tremendous controversy. Public meetings conducted in Ennis turned into personal attacks on Vincent and other department personnel. Anglers were polarized, with one side supporting Vincent's conclusions and the other side arguing that fishing would collapse if the catchable program ceased. Ultimately, Vincent's data prevailed. In December 1973, the commission accepted a department proposal to stop planting all rivers and streams capable of supporting viable wild trout populations, including the Madison. This became effective with the 1974 planting program.

1975-Present: Wild Trout, Habitat Protection, and Regulations

The cessation of planting catchables had several effects in Montana. It allowed numerous rivers and streams to reach their potential as wild trout fisheries. The Big Hole River is a good example. Six years after the catchable program ended, wild rainbow trout numbers had increased by over 400% and brown trout numbers had nearly doubled. By the late 1970s, many rivers in southwestern Montana supported over 1,000 pounds of wild trout per mile of stream and some supported up to 4,000 pounds per mile. If we were to look just at the economics of the situation, and compare the cost of raising trout in a hatchery (about $1 per pound) with the vast number of pounds raised for free in the rivers and streams of western and central Montana, it is clear that we made a wise decision in abandoning the catchable program.

Despite some initial uncertainty, the hatchery program in Montana was not adversely affected by the decision to manage for wild trout in our rivers and streams. Today, hatchery production is greater than ever, with most of the trout going into reservoirs and lakes. Hatcheries will actually play a greater role than ever in the future as Montana moves into the use and evaluation of different strains of rainbow trout to fit the individual needs of our lakes and reservoirs.

The commitment to wild trout management carried with it a commitment to habitat protection. To perpetuate the wild trout resource, streambank and streambed stability had to be protected. The passage of the Montana Natural Streambed and Land Protection Act in 1975 provided the first opportunity to protect streambanks and beds from habitat-altering practices by private landowners. This law, administered by the Conservation Districts with DFWP assistance, was a major step in perpetuating the wild trout resource. Referred to as the "310 Law" in recognition of the Senate bill which created it, this law dovetails with the 1963 Streambed Protection Act, which applies to cities, counties, and municipalities. Today, DFWP fisheries biologists spend a major portion of their time administering these two laws, which are so vitally important to the future of Montana's wild trout.

Another commitment necessary to perpetuation of our wild trout resource lies in maintaining sufficient instream flows. In recognition of this, the 1969 Montana Legislature granted the DFWP instream water rights on portions of all of Montana's blue ribbon streams, ensuring that wild trout would have enough water to maintain themselves in these waters. But unfortunately, most of the streams in Montana still had no instream flow protection at all. Then in 1973, the legislature, through establishment of a flow reservation system, created an opportunity to protect instream flow in other waters. This reservation process has been completed for the Yellowstone drainage, with the result that the wild trout of the Yellowstone River are now guaranteed sufficient water to maintain their populations. The reservation process is under way in the upper Clark Fork drainage, and the next effort is scheduled for headwaters of the Missouri drainage.

Commitment to wild trout management also implies recognition of the impact of anglers on trout populations. Heavy fishing pressure on such rivers as the Madison and Big Hole have necessitated restrictive regulations on portions of these rivers. Through use of catch-and-release fishing and slot limits (which allow only fish of certain sizes to be kept), we have been able to provide for the opportunity to catch, but not necessarily to keep, large trout in these areas. The bulk of our rivers and streams, however, remain open to general fishing with no special restrictions on tackle and fish size, thus providing a variety of angling opportunities—from the trophy trout of the Beaverhead River to the pan-sized brookies of our mountain streams.

The key to success for our wild trout management program in the future will center on streambank and bed protection and maintenance of sufficient instream flows. With healthy habitat, we can provide a rich diversity of angling opportunities into the future. Wild trout management in Montana has provided quality trout fishing opportunities rarely found elsewhere. Our challenge for the future will be to maintain these opportunities. ■

READERS RESPOND

"Weeds War" Wages Onward...

Mike Aderhold certainly had the stats on the weed war at Ninepipe (March/April 1985). Acreages burned, plowed, mowed, sprayed; dollars spent; manpower. How odd that he said nothing about a wildlife management plan and budget. A lot of folks who hunt and fish there are beginning to wonder if there is a wildlife plan after watching the first two years of the weed war.

The pheasant population which Aderhold correctly reported as being at an all-time high in 1983 had fallen to an all-time low by the fall of 1984. Moreover, it is going to stay that way unless the department replaces the weeds with cover crops and quits plowing, mowing, and burning as it is now doing well into the nesting season. How ironic to see such things going on in a wildlife management area at the same time the department is issuing news releases warning about the evils of such practices.

There is far more grain than necessary to feed the pheasants and waterfowl. Most of it rots or is plowed under. Vast tracts of grain are poor nesting cover, poor winter cover, and poor hunting because pheasants won't venture far from heavy cover to feed. What is desperately needed at Ninepipe is far more shelterbelts to provide heavy winter cover and more cover crops mingled with tracts of grain.

Finally, the weed war has rendered a huge percentage of the public hunting area not worth hunting—it is plowed or virtually stripped of cover. The area north of the reservoir is in particularly sorry shape.

Ninepipe should be a showplace where the department demonstrates its game management expertise and how wisely it spends the sportsman's money. But right now all it does is cause a lot of people to wonder about both.—*Martin Onishuk; Missoula, Mont.*

* * * * *

I just read Mike Aderhold's article in the March/April magazine. It's good to see these stories on weeds. There should be more of them. I'm sure that educating the public is our first step in weed control.

But I don't believe Mike has done much weed control work or bought very much chemical.

The article says that spraying with Roundup eradicated 85% to 95% of leafy spurge. No way! I wish it would. Besides, it would be silly to spray spurge on anything but crop ground (summer fallow) anyway. His point on fall application is well-taken, though.

The picture at the beginning of the article that is supposed to be whitetop is fanweed and does not warrant much concern. It's not a noxious weed and can be controlled in crop ground with 2, 4-D. It's persistent, as we've been spraying fanweed for 40 years and haven't eradicated it yet.

In 1983, with only 80% of the figures in, the Montana Department of Agriculture showed that farmers and ranchers in Montana spent $24 million for herbicides alone in controlling weeds. Most of that money leaves the state, by the way. No wonder the state is broke and farmers and ranchers are going out of business every day.

The article also talks about weed control experts. There are no such things as weed experts. What "we" know about weed control you could put in your teacup. There are folks working on learning things about weeds, and good luck to them. Control—doubtful; eradication—no way!—*Bill Reilly, Judith Basin County weed supervisor; Stanford, Mont.*

Sluice Boxes Revisited

One article in your March/April 1985 issue was of special interest to me—about the Sluice Boxes. From about 1916 to 1932, my father, Herman Nebel, was foreman of ACM's limestone quarry at Albright. My siblings and I went to school at Riceville. Rather than make the 10-mile round trip via our family "speeder" (an engine and flatcar used on the railroad line) each day, we boarded at Riceville during the week. But we still rode the speeder on the weekends. In winter, I remember my brother and I holding brooms ahead of the front wheels, to get rid of the snow and make for better traction. A cold business, indeed. Heated rocks or bricks kept feet warm, to a degree.

Rocks and porcupines were a constant hazard, winter and summer. In summer, the scent of syringa was ever present. Sometimes cows on the tracks gave a few scary moments. Altogether it was a wonderful place for kids to grow up.

In July 1983, my sister and husband, a cousin from Belt and his wife, and I walked to Albright from Logging Creek. We had to ford the creek twice, and the area itself had been changed drastically by time and two major floods. (I remember moving out of the house to higher ground almost every spring.) But it was wonderful, after 51 years, to see it all. Maybe we'll travel up the creek from Riceville when we visit Montana next time.—*Mrs. Art Cunningham; Enumclaw, Wash.*

Bluebirds—Maybe of Happiness

While driving up our country road on March 11, I noticed four of the most beautiful blue-colored birds I have ever seen. I knew they weren't jays as they had no topknot. They kept flying between the fence posts. I just had never seen anything or any bird like them in all my years.

Then your March/April 1985 magazine came and I read the article by Mrs. Joan Larson of Conrad. And I knew I had seen my first bluebirds. As most everyone knows, ranchers all over have had drought and grasshoppers, with very little snow this winter and very little rain this summer. Maybe the bluebirds are a good sign—bluebirds of happiness. I hope so!—*Betty Diegel; Glendive, Mont.*

It's Time To Take a Stand

I like *Montana Outdoors*, but I think I liked it better when some of the controversial issues were brought to light, things like land acquisition. We used to buy a lot of big game range for our wildlife, now we buy nothing. The value of land has dropped, but still we buy nothing except fishing access.

I recognize the fact that many landowners in Montana are annoyed whenever the public Fish and Game Department wishes to buy land for public use. I also recognize that there are about 5 million acres of public *state* land available to the public. At a time when access for the public is getting tougher and tougher all the time, there are people who feel that public state land should not be used by the public. This would create controversy, and this is what the public Fish and Game Department is for—to be on the side of the public, even if it does cause a controversy.

I am a hunter and a fisherman. Either this state is going to be a recreational state or an industrial state. People have to live, and if recreation has to be controversial, then let it be so. It's time to take a stand—and the time is now!—*Jack Atcheson; Butte, Mont.*

Those Bloomin' Algae

by Loren Bahls

GEORGE LANE

Fred Shewman of the Department of Health and Environmental Sciences Water Quality Bureau displays a water sample from Canyon Ferry Reservoir. A bloom of toxic blue-green algae was responsible for the death of nine cows, a bull, and a calf on the reservoir's west shore.

It was spooky. Canyon Ferry Reservoir, one of the most popular recreation areas in Montana for water sports, deserted on a gorgeous summer afternoon. People were avoiding the reservoir that day, as they would for many weeks to come.

Two weeks earlier, toxic algae killed nine cows, a bull, and a calf at the water's edge. Today I was recording information about algae conditions around the reservoir for the Department of Health and Environmental Sciences (DHES).

I stopped my car along the East Shore Drive to watch an osprey cruising over Magpie Bay. Oblivious to the warning signs, handbills, and newspaper accounts, she folded her wings and dove into the algae-tinted water, emerging with a lively 10-inch fish in her talons. She took it to a nearby snag where she pinned it to a horizontal limb and methodically consumed it.

Continuing my rounds, I pulled my car into the Shannon State Recreation Area to collect another water sample to test for toxic algae. A Colorado couple had just read one of the bright orange warning signs posted by the Department of Fish, Wildlife and Parks and, after seeing the State of Montana decal on my rig, asked me many questions about the little green beasties that were turning the water at our feet into pea soup.

The phone rang often that week. Cabin owners, concessionaires, campground managers, and recreationists from all over the state wanted to know more about this toxic algae that was cutting into their business and summer fun: "Can I eat the fish I catch?" "Is it okay to swim if I don't drink the water?" "Is the water in my well safe?" Sometimes there was apprehension or anger, but mostly just curiosity about what they could or could not do in the reservoir.

I tried to explain the dynamic and unpredictable nature of toxic algae blooms. But mostly I emphasized that by exercising a little discretion and common sense, they could enjoy the reservoir and still be reasonably safe from any ill effects of the algae.

What are algae? They are very simple plants. Algae are distinguished from other plants by the absence of features most of us associate with plants: flowers, leaves, stems, and roots. (An algae "bloom" or waterbloom is a sudden, explosive growth of algae in water; it has nothing to do with flowers.)

Worldwide, algae are at the base of nearly every aquatic food chain. In Montana, we can thank algae (and plenty of unpolluted water and good habitat) for the productive fisheries we boast about and enjoy. Every square inch of stream bottom or gallon of lake water contains thousands of microscopic algae, which are grazed by aquatic insects and crustaceans (shrimplike animals) just as pasture plants are grazed by cattle and sheep. These insects and crustaceans are in turn eaten by fish. Algae also help to produce the oxygen that keeps the other aquatic organisms alive.

But when something goes awry in a lake or stream, algae can grow like weeds and cause equally serious problems. To grow explosively or "bloom," algae need plenty of nutrients (nitrogen and phosphorus are preferred), the right temperature, and lots of sunshine. Some lakes are naturally rich in nutrients that come from the rocks and soils in the drainage basin. Other sources of nutrients include runoff from farms and developed forest land, wastewater from cities or industries, and improperly installed or poorly maintained septic tanks and drain fields.

When most algae bloom, they're nothing more than a nuisance. They snag fishing lines, produce an ugly scum on the surface of a lake, or create unpleasant tastes and odors in drinking water. But when the blue-green algae bloom, they can do these things and more: They can be deadly.

Blue-green algae are among the oldest and most primitive of all life on earth. They date from primordial times when most of the plants and animals with which

we are familiar were but a twinkling in Mother Nature's eye. Blue-green algae are sometimes called Cyanobacteria, after the bluish pigment (phycocyanin) they produce and their primitive bacterialike features. But because they are capable of photosynthesis, they are most commonly grouped with the algae rather than with the bacteria.

Although blue-green algae are common in Montana's rivers and creeks, only standing bodies of water—lakes, ponds, and reservoirs—can produce blooms of the potentially toxic species. The surface water must warm to 68°F or higher before a bloom can occur, which explains why blooms appear only in summer and often begin in shallow bays where water is more quickly warmed by the sun.

"Annie," "Fanny," and "Mike" are nicknames for three potentially toxic species of blue-green algae found in North America and in Montana: Annie—*Anabaena flos-aquae,* Fanny—*Aphanizomenon flos-aquae,* and Mike—*Microcystis aeruginosa.* All three were present in Canyon Ferry Reservoir throughout the summer of 1984. Blooms of these algae look like pea soup, green latex paint, or chopped hay or grass clippings that someone has dumped into the water.

Fortunately, toxic strains of these algae are rare, but there's no way to predict when and where they will appear. The genetic or environmental factor that triggers toxin production is unknown. Toxic and non-toxic strains can exist side by side in the same lake, and a toxic strain can appear where a harmless strain or no algae at all existed only a day or two before.

And the toxic algae can disappear just as quickly. Less than a day after the cattle died on the west shore of Canyon Ferry Reservoir, there was no trace of the waterbloom that killed them.

A common question asked during the Canyon Ferry episode was: "How do you tell a toxic strain from a harmless one?" The answer? You don't. They look the same, even under a microscope. The only way to tell for sure is to collect some of the algae and inject a small amount into a laboratory mouse. If the mouse dies, it's toxic; if the mouse is alive after 48 hours, it's probably not toxic.

Three episodes of toxic algae have been documented in Montana: Hebgen Lake (June 1977), Nelson Reservoir (July 1980), and Canyon Ferry Reservoir (August 1984). All three occurred in years of drought; all three were detected when dead cattle were found in and near water containing a bloom; and all three were caused by the same species of blue-green algae—Annie, *Anabaena flos-aquae.*

Annie produces one of the most deadly of all toxins known to man. Before its molecular structure was determined, scientists simply called it the "very-fast-death factor." The toxin produced by certain strains of Annie can kill a laboratory mouse in minutes and a full-grown black Angus bull in less than an hour. The toxin prevents the nervous system from signaling the muscles to function. The breathing apparatus shuts down, and the animal suffocates; a rigid neck is characteristic at death. Symptoms include staggering, muscle spasms, labored breathing, and convulsions. People who unwittingly ingest the toxin may experience sensations of numbness, dizziness, or tingling, and they may faint. There is no known antidote.

GEORGE LANE

Personnel from the Department of Health and Environmental Sciences Water Quality Bureau frequently monitored Canyon Ferry Reservoir during a bloom of toxic blue-green algae in August 1984.

The principal source of water for Canyon Ferry village and the City of Helena is Canyon Ferry Reservoir. Since conventional methods of treating drinking water do not remove or deactivate algal toxins, the untreated water used by these communities was tested for low levels of toxin. Samples were sent to Dr. Wayne W. Carmichael, an internationally recognized authority on blue-green algae now with Wright State University in Ohio, soon after the toxic bloom was detected; results were negative. Even if a toxin was present in a waterbloom near Canyon Ferry Dam, where the municipal water is withdrawn, it is unlikely it would get into the water system of either community because blooms are limited to the upper 10 or 20 feet of water, and the communities draw water from a depth of about 80 feet.

Several people living around Canyon Ferry take their water directly from the reservoir or from nearby wells. The DHES does not condone consumption of water from untreated surface supplies. But if the water intake in the reservoir is deep enough, it will escape the most concentrated part of the waterbloom near the surface. A deep and properly constructed well away from the shoreline will also afford some protection.

No human deaths have been reported from toxic waterblooms. This is not because people aren't susceptible, but because most people simply would not think of drinking water directly from a bloom. Does this mean that blooms are safe to swim in? Not necessarily.

First, you can't tell just by looking whether a bloom is toxic. And nearly everyone will inadvertently gulp some water while swimming. Children, who are more susceptible because of their low body weight, are even more likely to take in extra water while swimming or playing at the beach.

When people come in contact with a waterbloom, the chemicals produced can cause allergic responses such as rashes and hayfeverlike symptoms. These responses vary in intensity from person to person, just as people may be more or less sensitive to certain kinds of pollen.

To play it safe, it's a good idea to avoid contact with waterblooms. But in most cases, there's no reason to stay away altogether. Even during the height of the Canyon Ferry bloom last summer, some areas of the reservoir were relatively free of algae. During the Hebgen bloom of 1977, only the Grayling Arm—a relatively shallow bay—contained a waterbloom; the rest of the lake was safe to use. A rule of thumb might be: "Look before you leap."

So what about the fish you catch? Are they safe to eat? Blue-green toxins are not known to concentrate in fish. Even fish that have been killed by blue-green toxins probably would not have been exposed long enough to accumulate a dose lethal for humans. Vigorous fish caught on hook and line should be safe to eat, although they may taste "weedy" if taken in or near a waterbloom. The osprey I watched in Magpie Bay lived to fish again.

As waterblooms break apart, the decomposing algae generate very little oxygen through photosynthesis and the process of bacterial decomposition takes considerable oxygen out of the water. Even in a healthy condition, algae in a massive waterbloom will respire enormous amounts of oxygen at night. This can

create a localized depletion of dissolved oxygen, which may be just as deadly as algal toxins to fish and other aquatic life.

So far in Montana, we've been fortunate. No human deaths have occurred, and no cases of human illness due to toxic algae have been confirmed.

Concerning the Canyon Ferry bloom this summer, we owe our good fortune to James McMaster, the rancher who suspected that algae poisoned his cows; to Dr. Bradford Newcomb, the veterinarian who diagnosed the cause of the cattle kill; to the prompt notice and frequent monitoring provided by the DHES; to the mouse bioassays run by the Department of Livestock's Veterinary Diagnostic Laboratory in Bozeman; to the careful posting of the shoreline by the Department of Fish, Wildlife and Parks; and to all of those who heeded the warnings and avoided the waterbloom.

What caused the 1984 Canyon Ferry waterbloom? Blame it on the weather, the same unusually hot, dry, and sunny weather through July and August that wilted dryland grain crops and turned Montana forests into tinderboxes. When the wind blew on Canyon Ferry, it came out of the southeast, concentrating the algae along the west shore.

Canyon Ferry was not alone. Last summer, dense waterblooms were reported on Clark Canyon Reservoir near Dillon, Hebgen Lake near West Yellowstone, Homestake Lake near Butte, Lake Elmo near Billings, Ackley Lake near Lewistown, Whitetail Reservoir near Boulder, and Willow Creek Reservoir near Harrison. Fortunately, none of these other waterblooms was toxic.

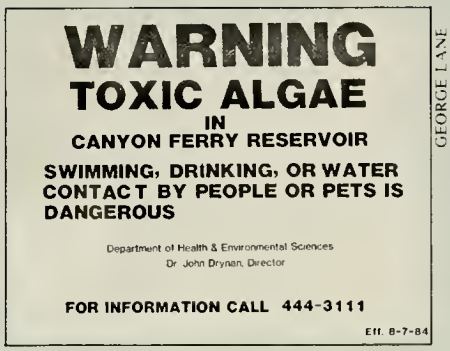
Long-time Canyon Ferry residents claim that waterblooms are nothing new and that the '84 bloom was no bigger than others. Research conducted by Prof. John Wright, now retired from the Montana State University Biology Department, bears this out.

In September 1956, only one year after Canyon Ferry was filled, Wright found that blue-green algae accounted for over half the volume of all algae in the reservoir. Two potentially toxic species—Fanny and Mike—were present.

In 1971 and '72, Ron Rada, a student of Dr. Wright's and now a professor at the University of Wisconsin, found blue-green blooms in July, August, and September of both years. Annie, Fanny, and Mike all were present. Rada reported that blue-green algae became abundant when the water temperature at the surface reached 63°F and that blooms developed when the temperature approached 68°F.

Surface water temperatures exceeded 73°F in Canyon Ferry last summer. However in Hauser and Holter reservoirs downstream (which receive cooler water from the bottom of Canyon Ferry Reservoir), the water apparently did not become warm enough to support dense blooms of blue-green algae.

Some people point to nutrients from agricultural and municipal sources upstream from Canyon Ferry Reservoir as a factor in the '84 bloom. Thanks to improved agricultural practices and sewage treatment, these sources are probably smaller now than in the past. However, runoff into Canyon Ferry during July 1984 was the fourth highest July on record. Since nutrient loads in rivers are largest during runoff, the unusually high flow in the Missouri River could have been another factor contributing to the Canyon Ferry bloom.



GEORGE LANE

Will it happen again in Canyon Ferry? Given the same weather, the bloom could be just as thick and just as toxic this summer. Toxic blooms are rare, but they're probably not as rare as we think they are. Three cases have been confirmed in Montana only because livestock happened to be watering at the exact location and at the precise instant of a toxic waterbloom. How many others have gone undetected? Dozens, maybe even hundreds.

Waterblooms are a fact of life in Montana. They can occur anywhere and at any time from May through October. Heavy concentrations of blue-green algae should be presumed toxic until proved otherwise. People should avoid waterblooms and keep children, pets, and livestock away. This is good advice for any lake or reservoir, not just Canyon Ferry.

But it doesn't mean you need to stay home and turn up the air conditioner when the dog days of summer roll around. Most lakes with waterblooms, especially the larger lakes, will have areas relatively free of algae. Resorts, marinas, and other businesses around the lake are sources of information about local waterbloom conditions.

For more information about toxic waterblooms, write the Water Quality Bureau, Montana Department of Health and Environmental Sciences, Cogswell Bldg.; Helena, MT 59620. The DHES also provides free analyses of waterblooms for the presence of potentially toxic algae. ■

On Being a Fish
continued from page 33

few minutes you are able to darken or lighten in order to blend better with your background. It happens automatically, and is an impressive talent. It's much more useful than your color-changing capacity as a human was; blushing won't protect you from predators.

We can't take the time to tell you everything that you as a fish can do, but we can spare a moment for two other standard features which ought to be of interest. First, you have gills. These (somewhere along your formerly human throat) serve to remove dissolved oxygen from the water so you can breathe (fish don't breathe water). You let the water in through your mouth, and out through the gills, and as it runs across a thin membrane on the gills oxygen is transferred to your blood (all this is less foreign to the human body than you might think; at one stage early in its development, the human embryo has gills). You ought to know (and you may end up wishing more humans knew) how delicate these gills are. If someone catches you and sticks a fat human finger in your gill to hold you still, not only will it outrage your sensitivities, it will very probably kill you. Many anglers proudly release fish that they have handled this way without knowing that they're missing the point.

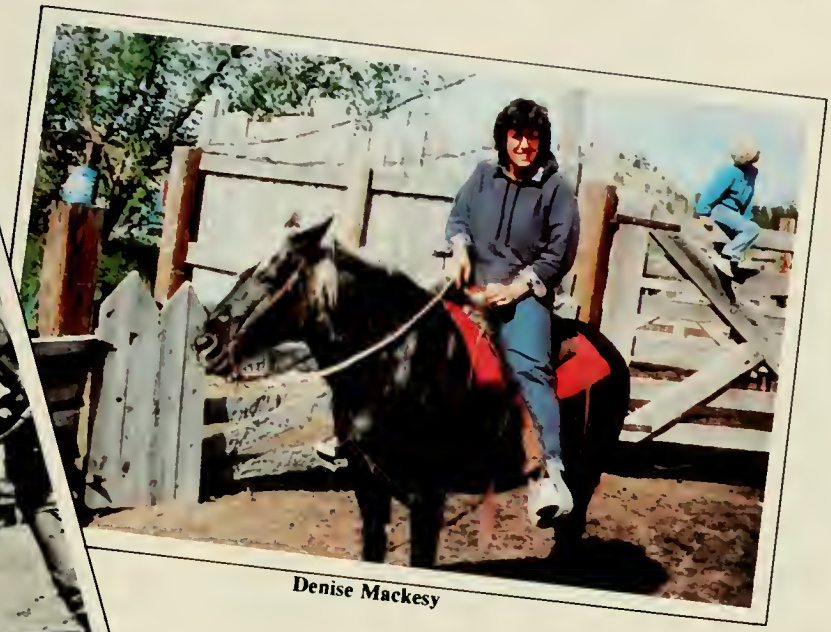
One other piece of equipment we'd point out is your air bladder. You have this sac inside your body which you can inflate or deflate. It is what allows you to remain at a certain depth (didn't you ever wonder why fish don't all bob to the top, or sink—thud—to the bottom?). You deflate it, and you sink (without it you weigh more than the water you displace). This, too, comes naturally, but again it can get you into trouble with fishermen; if one hooks you when you're very deep and unceremoniously winches you up to the surface, your air bladder won't have time to adjust, and you'll get the fish's version of the "bends." The bladder is very elastic, and under the worst such conditions it could double in size, forcing various other organs out of place and up through the esophagus. Imagine the discomfort.

Well, we could go on more or less indefinitely, introducing you to the wonders of your new body. But as you hold in the current, and go looking for food, and try to avoid the wading buffalo, you will quickly learn more than we even suspect about what a fish is, and will come to appreciate just how marvelous a creature you are. ■

reprinted from "Freshwater Wilderness, Yellowstone Fishes & Their World," by John D. Varley and Paul Schullery

WORKING IN YELLOWSTONE:

Mary Lowry



Denise Mackesy

THEN AND NOW

Many things change in 60 years, even in Yellowstone National Park. But as the following two accounts of a summer's work in the park attest, it has always been a wonderful place for young people to meet new friends, experience the grandeur of the western mountains, and prepare, as Mary Lowry says in her reminiscence, "for the more serious business of living."

Yellowstone Summer: 1924
by Mary Dawe Lowry

It was Aunt Mary who arranged for my sister Eva and me to work in Yellowstone National Park in the summer of 1924. She knew the woman who was hiring help and put in a good word for us, for which we were very thankful. Our life growing up in eastern Montana had been good, but not always easy. Mother had passed away in 1920, and Father two years after in 1922. I had just graduated from high school when my sister and I boarded a bus for Gardiner, Mont., a little town at the northern boundary of the park.

From Gardiner, we rode a big yellow bus on to Mammoth Hot Springs, where we were stationed along with 125 other "Savages," as we were called—all young folks from around Montana and many other states. If I remember right, I was the youngest of our group.

We were paired off into different cabins; ours was a large one, having four double beds in it, two girls to a bed—so you see we never lacked for company. Our cabin number was "513" and we named it "Kozy Kove." I could be mistaken on some of my statements; it all happened so many years ago.

A huge wood burning stove was the "heartbeat" of each cabin; it provided a surface large enough to heat bath water drawn from the tap outside, and allowed us to make late evening snacks. I know we had delicious trout suppers prepared on that beautiful old wood burner. How great the pine wood smelled as it warmed our cabin. My sister Eva made good white nougat and creamy fudge candy—she was noted for this, and it didn't take much coaxing to get her started.

All we "Savages" ate our meals in a large dining room reserved for us—not that we all ate at the same time, as each of us would stop for dinner after finishing whatever project we might be doing.

Eva and I were in the "tent girl" class, lovingly called "pillow punchers": Working together made our jobs easier. Our job was to clean up the cabins, change bedding, clean linens, sweep, tidy up, and set the "slop jars," or "ducks," outside on the step so the "Pack Rats"—the boys who tended to that job—could get their work done faster and see that the pitchers were filled with water. It all worked out beautifully after we caught on to what was expected of us.

We were meeting other young people from different parts of the country and colleges and schools we had never heard of. Come to think of it, very few of them had ever heard of Montana, so we found ourselves quite popular as we were from ranching country, riding horses and roughing it in the backcountry. Ours was a very different

By the shores of Yellowstone Lake

Eva and Mary

"Pack Rats" and "Pillow Punchers"

way of life from living back east in the bigger cities, which we knew very little about.

One afternoon soon after we arrived, becoming a bit lonesome, we wandered down to the corrals, where several horse wranglers were working over their string of horses for the "dudes" to ride. This was more like it—we could understand their western drawl and special names for some of their horses. We perched on the top rail watching the proceedings, and after the fellows were through they came and sat down by us. We soon knew their names were Barney and Don; after we became acquainted, we had promises of going riding with them some time.

This friendship turned into a marvelous experience for Eva and me. It wasn't long before I was allowed to take a few dudes out on short trips, following well-worn trails. The wranglers said they knew we were from ranch country by the way we handled horses.

One day we rode with Don and Barney out to a cabin on Glen Creek, where they had to pick up a few horses. The fellows brought the lunch. I still remember a peach pie, made from dried peaches; I don't recall which of them made it, but I do remember how good it was. We experienced a rattling thunderstorm that day. Eva and I retreated to the low-hanging branches of a sturdy pine to get out of the slanting silver rain while the men got their horses into the corral.

I must mention one of our first experiences after being on the job a few days. Two fellows, "Pack Rats," came to the door of the cabin we were cleaning to collect the "ducks" to be emptied and cleaned. They lingered awhile, giving us their names and asking ours, where we were from, etc. One wanted to tell us a story; well, we thought that would be all right, until it got a bit rank. I didn't even know what he was talking about, but I bristled up, hands on hips, and stamped a foot. declaring, "I'll have you know we don't listen to stories like that." Their surprised eyes and puckered mouths showed how surprised they were. They came back later, returning the cleaned "ducks" and filled pitchers of water and apologized for being so smart. It turned out that they became two of our best friends, and asked us if we would personally clean their cabin, which we did, receiving a generous "tip" for our help each time.

When the big yellow buses brought in the sightseers and guests in late afternoon, usually just before supper, we "Savages" gathered to greet them with songs as they stepped down from the bus. One was "riding the yellow, yellow bus" and one was about white cakes of Ivory soap that all the cabins were equipped with. I can't recall titles of other songs, but we were a noisy, enthusiastic group, thoroughly enjoying what we were doing.

A big event of the season was the cookout put on by the wranglers—steak and fried fish like you dream about. The steaks had been ordered, but no one was available to ride to Gardiner to pick up the meat at a shop there, so I offered to ride in, with saddle bags across the saddle, to carry the meat. I felt quite important, making the trip without any problems, knowing I was helping in a small way, and loving every minute of the four-mile trip.

The cookout that night was a fantastic experience; if I remember right, it was close to the 4th of July, with a beautiful full moon lighting our way. The wranglers had huge, long-handled fry pans set on big grates over the fires, burned down to the perfect bed of coals for searing the steaks. Huge pots of coffee steamed, ready for the thirsty "Savages."

Several guitars and an accordion were produced, and the wranglers had mouth organs in their pockets, so you might know the singing and chorus harmonizing was an experience none of us will forget.

The fireflies that night were everywhere, flashing their miniature lights, casting an eerie glow through the dark shadows under the pines.

When we finished our duties each day—usually we were through cleaning by noon—we could go to the kitchen and have lunches put up in boxes we could carry with us; thus, we enjoyed many afternoon hikes into the wilderness along streams teeming with trout. Beauty on every hand tempted camera buffs. I had an old Eastman camera and took many beautiful pictures; of course, they were in black and

white then; we didn't know about color film or what fantastic pictures we would be taking now.

About this time Barney and Don, the wranglers, had to make a trip out of the park to pick up some saddle horses. We were sorry to see them go but we became acquainted with Ben and Hank, who worked in the laundry at Camp and were great fishermen. Many were the trout suppers we enjoyed with these two, who enjoyed the whole outdoors as much as we did. Sitting around campfires you became pretty well acquainted, swapping stories and adventures.

By now the tourist season was winding down to closing time, and we were all making plans for a tour of the park on the big yellow buses, the Park Company's gift to us for helping through the tourist season. We had overnight accommodations at Canyon Camp, dances at night, good food for each meal, and a marvelous time with all the "Savages."

Our associations with the girls in our cabin and cabins nearby are unforgettable. We met so many fine young folks. We enjoyed so many impromptu dinners of fresh mountain trout or steaks, just any excuse to trail the mountain streams with friends who enjoyed the outdoors as much as we did.

I remember Eva and me standing at open windows of the cabins we had just cleaned, sniffing the exhilarating pine-scented air flowing down the canyon, the atmosphere sort of like Indian summer, hazy and a bit smoky. We knew how lucky we were to be experiencing this marvelous adventure together. We were storing up memories to lighten the serious business of living.

Yellowstone Summer: 1983
by Denise Mackesy

While most college seniors are busy writing their resumes, attending workshops on how to interview, and preparing for the long climb up the ladder to fame and fortune, I was busy filling out an application for T.W. Services and hoping for a chance to work in Yellowstone National Park. I had two brothers who graduated from college before me, and I saw what life after college was like—not my idea of a picnic. The thought of commuting two hours from my mother's home on Long Island into the Big Apple was not very appealing. Why should I do what society expected of me when I could hike, fish, ride horses, and live in America's first national park? As my father said, "I had to find myself," and I knew that that would not happen on the Long Island Railroad. So while friends were preparing for careers in New York City, I hopped on a Greyhound bus headed for Livingston, Mont., and a summer job as a maid in Yellowstone.

Somewhere near Fargo, N.D., I started meeting others who were headed out to work in Yellowstone, and by the time we reached the park headquarters at Mammoth Hot Springs, we were quite a large group. I'll never forget that ride to Mammoth. I had never seen so much wildlife and so few people. Where was everyone? There was so much land. Why hadn't someone put up a shopping center, movie theater, or housing development?

Upon arriving at Mammoth, we were rushed into the E.D.R. (Employee Dining Room) because dinner was almost over. After dinner, we went to the dorm and paired off into roommates. As might be expected, I roomed with the girl I had sat on the bus with, although I later switched and roomed with a girl I worked closely with. There are four dorms in Mammoth: Aspen (the most popular because of its carpets and suites with private bathrooms), Spruce (a smaller dorm but it has a large front porch), Juniper (fondly called Jupiter because it was a little louder than the others), and Lodgepole (very small, with no closets). We wound up in Juniper, and although it was

The annual talent show

Livingston, Mont., at last—after 58 hours on the bus

noisy, we were very close to the E.D.R. and work—definite advantages.

After three days in training, where we learned everything from bathroom cleansers to vacuums, we were given our room cleaning assignments. If I remember correctly, I only lasted four days as a maid. One night after work, some co-workers and I went to the fast-food restaurant (nicknamed McMammoth's) for employee scoops of ice cream (that is one thing you learn fast, to order an ice cream cone with an "employee scoop," somewhat larger than the average scoop). I had worked in fast-food restaurants on my summer vacations from college, and felt so at home that I knew this was where I belonged. After a few looks of

desperation, and very little begging, I was transferred to the Food and Beverage Department.

I began making friends with people from all over the United States, but it was awkward at first trying to find the group I fit in with. After leaving great friends from high school and college, I had to start over. Some nights I would lie awake and wonder why I was out here with strangers, instead of at home with a loving family and friends. In the beginning, most evenings were spent taking long walks and hikes, going to movies twice a week, or drinking beer or coke and munching popcorn in the Employee Pub.

It was during these long walks or shared bags of popcorn that I gained a lot of insight into the lives of people from Arkansas, South Carolina, Minnesota, Illinois, Montana, Arizona, and many other places. We were fortunate to be in Mammoth and only five miles from Gardiner, where we could shop, see a movie, or frequent one of the five watering holes, depending on our mood. Eventually I became friends with Bobby, the cashier at the horse corrals, and the wranglers, Ellen, Theresa, and Pete. Pete was a tall, thin, wonderful guy from Montana, a real cowboy who took me under his wing. I became Pete's W.I.T.—Wrangler-In-Training. God bless any wrangler who has the patience to teach a girl from New York about horses. I never did quite get the hang of buckling up a saddle, but was very proud of myself when I lifted the heavy bales of hay into the troughs while refusing help from Pete. Pete would sit on his horse, O.J., with a long rope with a hook in it. I would swing the hook into the bale, and Pete would drag it to the trough where I would lift it onto my knees and toss it in.

An outing on Yellowstone Lake

I remember one morning when I was out at the corrals and an inspection was coming. I asked Ellen, "What can I do to help?" This prompted her to hand me a broom, giving me that once-in-a-lifetime chance to sweep out a stable, my informal initiation into the world of horses. I would help out when I could and was compensated with rides when space was available. Not a bad deal in my opinion, a little hard work in exchange for mountain trail rides in Yellowstone National Park. My days at the corrals with Pete, Ellen, Theresa, and Bobby constitute some of my fondest memories of Yellowstone. And to this day when I see or smell horses, I am transported back to my first summer at the park.

I was fortunate to be in the park the first (and possibly only) year that a group of employees got together to put on a play for the tourists and other employees. During my search for people and activities, I learned about the upcoming production of "A Streetcar Named Desire" and decided to try out for a small part. I just wanted a part with a few lines to give me the feel of being in a stage production. Tryouts went well, although I was extremely surprised to find my name next to the part of Stella, one of the leads. For wanting a little part, I wound up in nine of 11 scenes! At that time, I did not know that three to five of my nights would be spent in rehearsal, making our own set, and getting our own costumes.

It was all very tiring, yet I'll always remember the excitement of packing up the set at Mammoth and traveling to Old Faithful, Lake, or Canyon, unloading the truck, setting up, and getting dressed for a three-hour performance. After the show, we would break down the set, pack it up, and drive home to catch some sleep for a 5 a.m. shift. It was hard work, but it gave me a sense of purpose and started a great friendship with Julie—my "older sister Blanche" in the play—a wonderful friend from Massachusetts.

My days were spent serving burgers to hungry tourists, nights in play rehearsal, and any free time hiking and exploring the park. You feel so close to nature and to God hiking up a mountain past meadows of wildflowers arranged more beautifully than could be done by the world's greatest gardener. There's also that wild, wonderful thrill while you're hiking or camping, wondering if there is a bear in the vicinity. Then too, there's a sense of excitement and anticipation knowing your work shift is almost over and in a few moments you and your friends will be hopping into your bathing suits, and hiking down to the Gardiner River to sit and relax in the hot pots.

Hot potting was a sport I truly excelled in at Yellowstone. The hot pots are an area of the Gardiner River where the Boiling River (with its hot thermal water) flows in and forms a wonderful natural hot tub. Surrounded by mountains, one can soak up the sunshine, relax, and be grateful for taking the chance to spend a summer in Yellowstone National Park.

Park employees are entitled to a few fringe benefits, such as riding the T.W. Services buses for free around the park and being eligible for discounts on raft trips with certain raft companies. I have always been somewhat leery of boating and rough water, but could not pass up the opportunity to float the Yellowstone River in Montana or the Snake River in Jackson, Wyo. Most park employees, possibly all, take at least one trip to Jackson, to stroll around town, sit on a saddle barstool at the Million Dollar Cowboy Bar, and to see the Grand Teton mountain range. My first sight of the Grand Tetons left me with a sense of awe; I don't think I have ever seen anything more beautiful and inspiring in my life. The more I saw, the more I wanted to see. This Long Islander began to realize there is a big, beautiful world out there waiting to be explored.

As summer drew to a close, I would try not to let a day go by without being thankful for all that I had experienced and learned. It was as though my fellow employees and I were packing up all our memories, feelings, and adventures into a little trunk in our minds—a trunk which, every time we smell a pine tree or a campfire, see a full moon, or hear a coyote howl or an elk bugle, will be reopened to recapture the beauty and excitement we felt during that special time in Yellowstone National Park. ■

Missouri Headwaters State Park

UNFOLDING HISTORY

story and photos by Doug Monger

Interpretive sign

In July 1805, the only visitors to the present site of the Missouri Headwaters State Park were local Indians and members of the Lewis and Clark Expedition. The expedition was commissioned by President Thomas Jefferson to explore the Louisiana Purchase. In doing so, the explorers found abundant wildlife, beautiful scenery, and attained their goal: the headwaters of the Missouri River.

After members of the expedition carried back word of this new country, the headwaters area served as a trapper outpost and fort for those seeking their fortunes as fur trappers. Hostile Indians brought a quick end to these outposts. Time passed, and a hopeful few established Gallatin City, intending to capture the "inevitable" Missouri River trade, thus becoming a commercial center for Gallatin Valley. These dreams vanished, leaving behind only a few of the original city's structures.

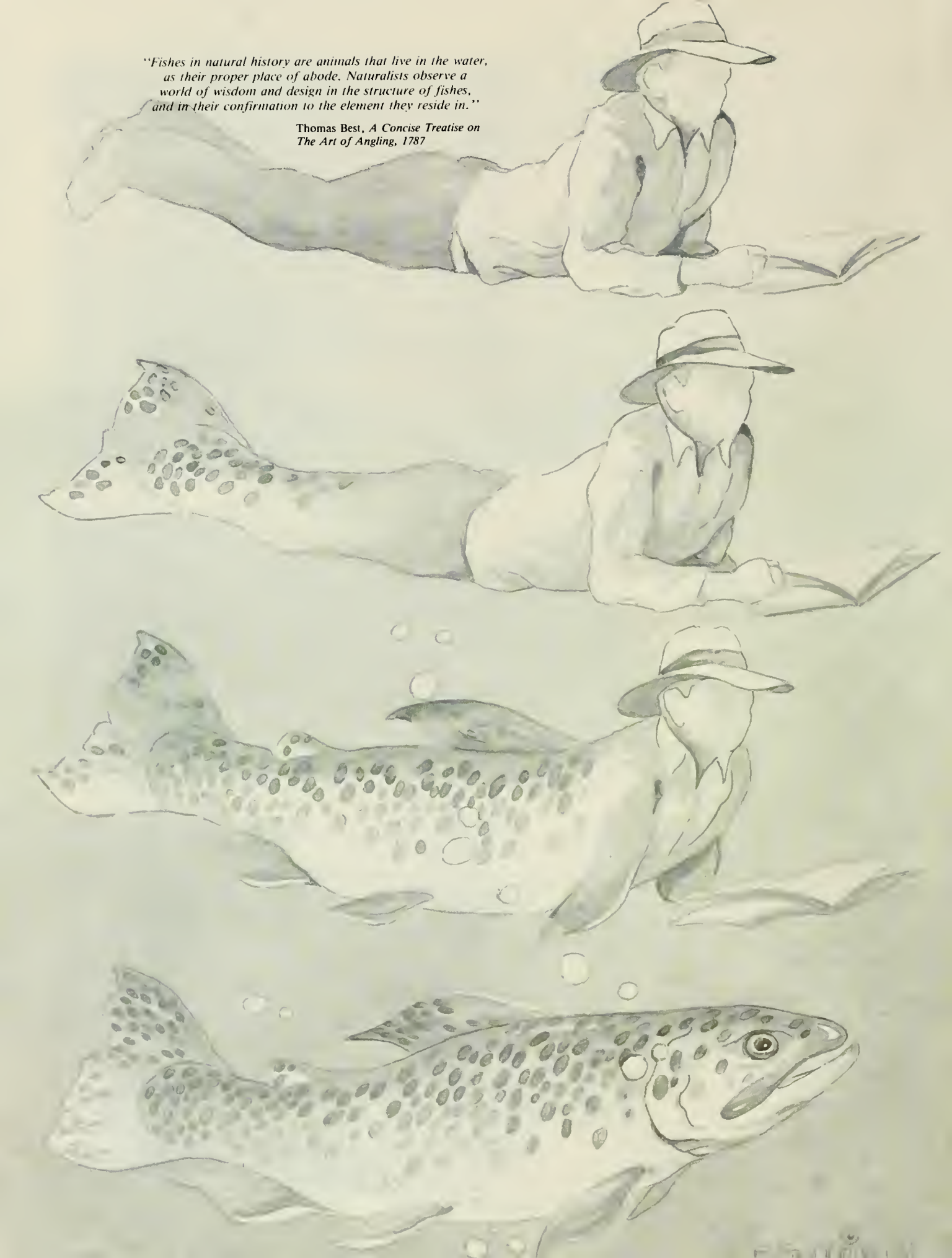
Picnic area, Gallatin River at right

Today, 40,000 visitors from all walks of life explore and enjoy the historic Missouri Headwaters State Park. Modern adventurers are greeted by an overnight camping area, grassy picnic spots, and a multitude of interpretive displays which unfold the rich and colorful history of the area. This 500-acre park, crossed by the Gallatin, Madison, Jefferson, and Missouri rivers, was chosen and developed as Montana's 1976 Bicentennial Park. Come to the Headwaters, and visit one of Montana's proudest historic and scenic parks. ■

Gallatin City Hotel

"Fishes in natural history are animals that live in the water, as their proper place of abode. Naturalists observe a world of wisdom and design in the structure of fishes, and in their confirmation to the element they reside in."

Thomas Best, *A Concise Treatise on The Art of Angling, 1787*



On Being A Fish

Fish fill us with wonder. Because they are usually seen only after they have been removed from their world and lie gasping or dead in ours, most people have little appreciation for fish as animals, or even as beautiful objects. The dead fish is a cold slimy thing of slapstick humor and trophy rooms. The live fish, at home in the water, is as unlike its fish-market counterpart as an Olympic athlete is unlike a human corpse. There is no comparison.

The fish is essentially a muscle, or a network of muscles, strung over a long and extremely narrow bony skeleton. To get yourself into the mood of fishness, imagine the following: you have no shoulders, neck, or chin. Your eyes, nose, and mouth are moved to the very top of your head. Your arms become shortened and reform as small fins. Your chest cavity becomes three times as deep as it is wide, and one or more fins sprout along your backbone. Your legs join into one member, and their bones are replaced by a continuation of your backbone, which runs clear to your feet, which reshape themselves into a tail. By now you are uncomfortable standing vertically, so you lean over and slip into something more comfortable—water.

Imagine yourself undergoing this transition, and many things about fish become clear. Imagine yourself transformed. You want to move forward through the water, but you have no legs to kick, and your new fins are much too small to propel you. You move as you would were your legs tied together and your arms tied at your side. You move by "waving" your entire body. Because your new backbone is designed to bend to the side most easily, this is the direction in which you wave. Starting near your head, you tighten the body muscles on one side, and lengthen those on the other. You then send this little curve toward your tail, and as it reaches there you conclude it with a flip of the tail. It pushes you forward. In a sense, you wiggle your way through the water, using the final stroke of the tail at the end of each wiggle for more power. It's really a very simple motion, once you realize you can do it.

"So why do I have all these fins hanging off me?" you ask. The fins are for stabilization, stopping, and turning. Your "arm" fins can be tilted and canted in many ways, to gently lift as you move forward, or merely to help balance in a steady current. And remember, if you're going to live in a stream, you will spend most of your time swimming just fast enough to stay where you are. In fact, if some sadistic nine-year-old caught you and removed all your fins (even your tail), you could still function. You could get used to it.

If you could see yourself from above, in a moving stream, your various fins would indicate some things about the water. For example, the farther out from the body you have extended your pectoral fins (your former arms), the slower the current must be. It's the same principle that causes a diving falcon to fold its wings against its body to reduce wind resistance. When a buffalo wades into the river and nearly steps on you, you fold up everything you can find and dart for safety.

It has been pointed out that paired fins function as hydrofoils, which helps us understand the size of fish fins. The ability of a fin to lift a fish is directly proportional to that fin's surface area, so larger fins work better where there is more work to be done, that is, where there is more current speed; a fish needs a lot of "negative lift" to hold its place in a fast current. The best example of how fish are adapted to high current speeds, among park fishes, at least, is the sculpin, a bottom hugging, fast-water species with extraordinarily large fins for a fish its size. They're almost like paddles. Depending on where you, as a fish, spend most of your time, your fins could be tiny or large, or anywhere in between.

As a fish you have most of the senses you had as a human, but in differing qualities. Your eyes are well developed, and are quite similar to human eyes. You can't move them much, but you've got one on each side of your head, so you have a much wider field of vision. Since water is usually opaque, seeing at any great distance is impossible, so your nearsightedness isn't much of a problem. You can distinguish some colors, but probably not all (if we knew more about this, a lot of fishermen could settle a lot of arguments). You can't blink.

Your sense of smell is not limited to your nose. There are small sensory organs scattered over your skin that seem to serve the same purpose. The same goes for your sense of taste; it's in your mouth, and also on your skin.

You do have ears, though they aren't visible externally. They are buried in your skull, and receive vibrations from external sources as do human ears. They are far more important to you (and to humans, really) as your center of balance control, though.

Speaking of vibrations, you have a sensory organ that humans lack; the lateral line that runs along your sides contains many nerve endings that seem to be concerned with vibration detection.

All these various nerve endings and secondary sensory organs make your skin a pretty important place. Your skin contains numerous glands which excrete slime. The slime is a protective coating; it seals the scales against fungi and bacteria. As sophisticated as this arrangement of skin, scales, and slime is, you have a surprising ability to change color; almost all fish do, to some degree or another. In a

continued on page 26

by John D. Varley and Paul Schullery
illustrated by Robert Spannring

Montana's Wilderness Fishery:

SHOULD WE MANAGE IT, OR LEAVE IT ALONE?

by John Fraley

Montana has been blessed with a rich treasure of wilderness waters. Thousands of mountain lakes dot our wilderness areas, and several thousand miles of wilderness streams course through the backcountry. Each year, fishing has become more a part of our wilderness activities. Over half of the visitors to Montana's wilderness areas enjoy angling for colorful, scrappy trout in clear waters surrounded by brooding mountain peaks and magnificent glacial sculpting. Fishing in these areas provides an opportunity for a quality wilderness experience—something unique and not easy to find in today's civilized world.

The Department of Fish, Wildlife and Parks (DFWP) is responsible for fisheries management in Montana's 15 congressionally designated wilderness areas (3.4 million acres). Many people believe the best management for wilderness fisheries—and for wilderness in general—is to maintain a laissez-faire policy: No management is good management. This was the initial attitude of some of the pioneers in the wilderness movement such as Aldo Leopold and Bob Marshall. "Draw a line around it, and leave it alone" was sufficient during the early days of wilderness protection, when public use was only a fraction of what it is today. However, with the rising use of our wilderness waters, the DFWP has become increasingly concerned about developing a consistent philosophy and management strategy among the department's seven administrative regions that will be in the best interest

SEAN LOGAN

of the vast wilderness fisheries resource.

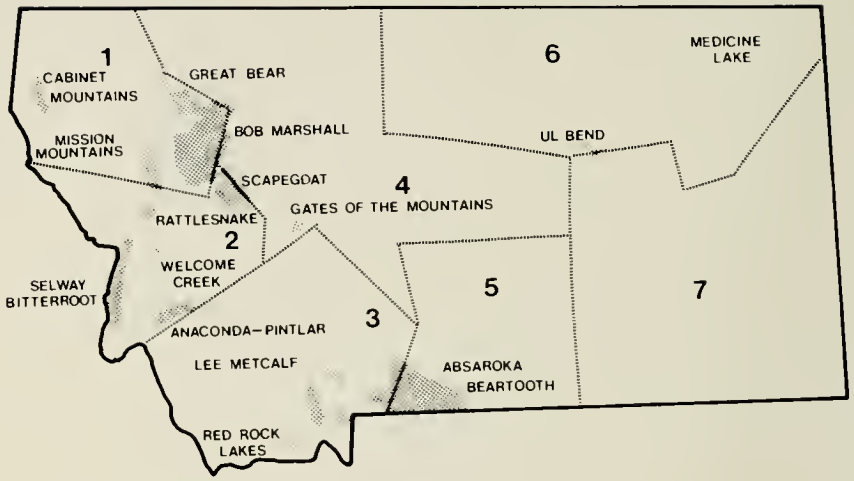
What is the extent of Montana's wilderness fishery? There are nearly 500 lakes within the state's wilderness boundaries with productive fisheries. Only a handful had fish originally, but over the years, trout were borne into these sparkling jewels by backpack, mule, and helicopter. The majority of the lakes now support natural reproduction, but some lack spawning areas and must be planted regularly. About 260 of the productive lakes are perched in the high country of the Absaroka-Beartooth Wilderness. The Bob Marshall complex, largest of the contiguous wilderness areas, surprisingly has only 34 lakes with fish populations; it is instead a land of large valleys and streams. About half of the 500 wilderness lakes are populated by species not native to that particular part of the state, while half are occupied by native species. The productive lakes have become a drawing card for wilderness visitors.

Approximately 1,000 miles of productive streams flow within Montana's wilderness boundaries. With the South and Middle forks of the Flathead River within the Bob Marshall Wilderness, DFWP Region 1 (Kalispell) has nearly 400 miles of streams inhabited by game fish. Most of the wilderness in Region 5 (Billings) stands at an elevation of about 10,000 feet, and only some 70 miles of streams within it are productive. Most wilderness streams away from major trails are visited by anglers only occasionally.

Lakes and streams within wilderness boundaries support at least 10 species of game fish. Cutthroat trout (westslope and Yellowstone) are the most common, followed by brook, rainbow, bull, golden, and brown trout; Arctic grayling; and mountain whitefish. Brown trout are newcomers to the wilderness due to the recent inclusion of the Madison River's Beartrap Canyon in the Lee Metcalf Wilderness. Some-time residents, kokanee salmon have been seen occasionally in the Middle Fork of the Flathead within the Great Bear Wilderness.

How can wilderness designation affect fisheries management? Fisheries management is impacted in many ways by wilderness designation.

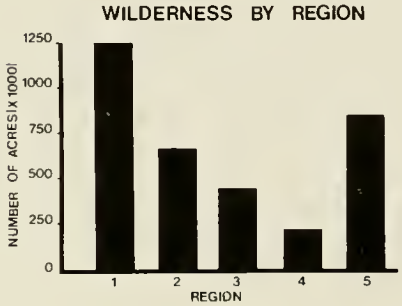
MONTANA WILDERNESS AREAS BY REGION



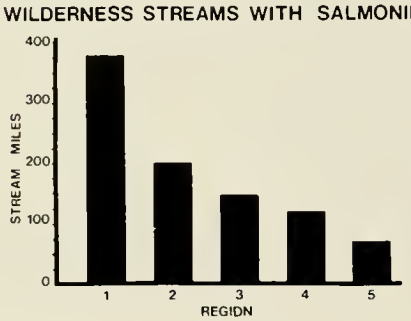
Lakes and streams within wilderness drainages are protected from most man-caused impacts, so they offer a haven (and protection for the gene pool) for many sensitive fish species, such as the westslope cutthroat, grayling, and golden trout.

Because access is often difficult, fishing pressure is usually light in wilderness areas, allowing maintenance of trophy fisheries in some lakes. Wilderness waters in the Bob Marshall complex provide spawning areas for the important trophy bull trout fishery of Flathead Lake. Bull trout spawners, from 4 to 12 pounds and more, grow to maturity in the lake and then journey as much as 100 miles upstream through the Flathead River system to small wilderness streams. The Bob Marshall Wilderness thus serves as a protected spawning and nursery area for a drainage-wide fishery.

WILDERNESS BY REGION



WILDERNESS STREAMS WITH SALMONIDS



Wilderness designation can pose some difficulties to fisheries managers. These factors have contributed to problems in establishing a solid statewide fisheries data base for wilderness waters. Access for study is difficult, field operations are usually time-consuming, and motorized equipment cannot generally be used. Special methods, such as snorkeling or hook and line, must be employed to assess stream fisheries.

Is it possible, or even desirable, to develop a management plan for the state's diverse wilderness fishery? The concept of wilderness fisheries management is in its infancy. Many controversial questions have been raised: Should barren lakes be planted? Should fisheries biologists be allowed to use techniques for estimating fish populations that involve motorized equipment or chemicals? Should non-native species be planted? Should endangered species be planted?

Fundamental philosophies of wilderness fisheries management—such as the balance between the role of wilderness in providing recreation and its role in protecting a fisheries gene pool—have barely been addressed, let alone agreed upon by managers.

Fisheries resources in Montana's wilderness are managed according to general guidelines agreed upon by the

DFWP director and the regional forester for Region 1, U.S. Forest Service. The department's regional fisheries manager and the district ranger for a particular wilderness formulate the management strategy for a resource of statewide and national importance.

Management strategies in wilderness areas are not consistent among the various regions. In some regions, barren lakes which never supported fish have been planted. Non-native species are planted in some regions, and in some they are not. Some managers advocate use of motorized equipment, some do not. On a statewide level (with the exception of the Bob Marshall complex), creel limits on wilderness waters are generally the same as those outside wilderness boundaries.

The wilderness fishery is changing yearly without a consistent management strategy or review. It is time to consider an aggressive statewide fisheries management strategy for *all* of the state's wilderness areas. Because we have not done this, fisheries values have been given limited emphasis in national forest and wilderness management plans. Effective plans with other agencies are impossible until a statewide fisheries plan is in place.

The first step would be to assemble all existing information on the fisheries resources within our wilderness boundaries. Very little additional inventory would be required. Most of the information exists; it simply needs to be compiled, checked, and entered into a statewide data base. Highly detailed information is not needed for a statewide plan—all that is really needed is species present, general habitat capacity, and areas of special interest within each drainage. Long-term information about the condition of the fishery could be obtained by periodically interviewing fishermen and by monitoring a few key species, such as bull trout.

Once an adequate data base has been compiled and organized, plans could be made on a regional basis. Some department regions already have management plans for their wilderness lakes or streams; these should be evaluated and fine-tuned by a statewide cooperative group and included in the statewide management plan. All wilderness waters can't be managed by the same criteria; they are too diverse for that. But the need exists to address all the fisheries management concerns of wilderness throughout the state and organize a plan under one cover. Public review and involvement and consideration of a wide range of past and present philosophies should be an integral part of the process.

Montana's wilderness is a priceless national resource offering excitement, beauty, and solitude to thousands of people. It seems logical that wilderness fisheries management should be light-handed, with a minimum of influence on natural processes, to be consistent with wilderness values. More important, it will necessarily become the management of people as use continues to increase. The days may be gone when wilderness existed as "a land where the mountains are nameless and the rivers run God only knows where." If special regulations or other management procedures are not consistently applied to our wilderness waters, the condition of the fishery may decline.

The stage is set for debate, and the question is: Should we intelligently and sensitively manage our wilderness fishery, or should we leave it alone?

BILL PRYOR

Montana's wilderness areas contain almost 500 lakes with productive fisheries. Albino Lake, pictured here, is one of 260 productive lakes in the Absaroka-Beartooth Wilderness.